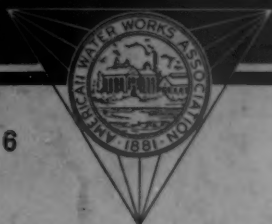


# JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION



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## **Construction and Use of Well Screens**

*By E. W. Bennison*

**T**HE proper screen to use in the construction of a permanent dependable well is considerably more of a problem than the average well driller or user thinks. It is absolutely essential that some of the fundamental principles be understood and considered before construction is undertaken.

The ideal well screen, of course, should be one that can be quickly and cheaply constructed of materials that will last forever, make available all of the water in the water-bearing formation with a limited drawdown under pumping, without any deterioration or the usual difficulties encountered in constructing and maintaining a screen in a well.

Strange as it may seem, the ideal well screen has never yet been constructed and probably will not be for many years to come. We are steadily improving our technique as methods and materials used in screen construction are developed, but we have not yet reached perfection. By reviewing the history of well construction and noting the changes that have taken place in recent years, we can trace the line of reasoning used both in the construction methods and materials used in well screens.

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A paper presented at the Illinois Section meeting at Urbana, Illinois, April 20, 1939, by E. W. Bennison, Office Engineer, Edward E. Johnson, Inc., St. Paul, Minnesota.

The important points to remember in considering a well screen are:

1. That it is not a strainer to hold out all or a large part of the formation around it, but rather is it a stabilizer or device to support the water bearing formation during development and consequent pumping.
2. That the screen opening should be relatively large and based on an intelligent interpretation of a sand analysis and the local ground conditions.
3. That the screen or stabilizer should have as much opening and as little blank wall space as possible in order not to shut off the natural openings in the water bearing formation, and also to reduce the action of bridging to a minimum.
4. That the total volume of open space between spherical particles in a given volume is the same regardless of how large or how small the particles, provided they are all of the same size.
5. That if smaller particles are placed in the open spaces between larger particles, there will be a reduction in the total volume of open space. In a sand gravel formation, then, the greater the percentage of fine particles the lower the percentage of voids or porosity with a consequent reduction in permeability or capacity for yielding water.
6. That the same is also true in case larger particles are used. All of which means that the uniformity of grading of a mixture of particles is more important from the water yielding standpoint than the size of the particles themselves.
7. That bridging of particles will take place in a formation and arches or bridges will be formed over openings and between particles where the flow of water is in one direction.

#### **Little Known Forty Years Ago**

As late as forty years ago, very little was understood as to why well screens failed or how water moved through the ground. Practically nothing was known about the scientific or engineering principles involved in screen design or construction, though when the first slotted screens came out, it was realized that practically all well troubles were caused by corrosion, erosion, incrustation, sand jamming or sand pumping of the screens—or strainers as they were then called.

During recent years a large variety of well screens constructed of all sorts of material have been brought out. One of the most popular

screens some years ago was the slotted screen made by milling a brass tube from the inside. Most all screens of this period had one common fault in that openings were made smaller than the sand to be encountered as it was thought the purpose of the screen was to hold the formations out of the well rather than to let them in. Some screens of this type are still used in special applications where they are best adapted. It was found by experience that practically all of the first types of present day screens including the slotted screens were not much of an improvement over the earlier types due to our lack of knowledge of the scientific aspects of screen design and the phenomena of corrosion and incrustation.

### **Knowledge of Sand in Filters an Advantage**

To add to the difficulties of the situation little was known about the character, occurrence or hydraulics of underground water in connection with well construction and it was not until sand filters began to make their appearance that much thought was given to improving the design of well screens. Then engineers began to understand the properties of sand such as porosity, permeability, uniformity, arrangement, etc. as used in sand filters. This knowledge was soon taken advantage of and applied to well screens with the result that screens are now built of materials whose physical and chemical qualities are known as well as the mechanical stresses that the screen will be subject to. A screen can now be furnished for most any condition of water or sand that may be encountered in the construction of a well.

Much time and money have been spent by some screen manufacturers to find out the best materials to use in their screens and also the proper design of screens for varying ground conditions. There are still many engineers and well drillers who are slow to subscribe to the development of recent years and insist on some "pet" screen design of their own being used. There are even some screens offered by manufacturers as "cure-alls" that have no scientific foundation. Time will expose any well screen of faulty design as the agencies that destroy and render well screens useless are still with us and always will be.

Let us consider then the ideal well and screen referred to earlier, as a construction problem, which if successfully completed will furnish us with a permanent, dependable and satisfactory water supply at a reasonable cost. The well must first be properly located in the best

water-bearing sands available. If the location of these formations is known—well and good; if not, then they must be located by the use of accurate dependable testing methods by experienced people. Secondly, the type of well and method of construction must be considered carefully and the one selected that with proper screens will develop the maximum flow of water at a minimum loss of head, both in the well and the sands surrounding the well. This depends entirely on the formation in which the well is to be built. Thirdly, screens must be constructed of materials that will resist the corrosive or incrusting tendencies of the ground water that will be pumped. The inlet openings in the screen must be of such shape and size that they will not tend to clog up, neither will they be so large that the screen will pass sand under pumping and induce erosion of the screen.

#### **Screen Controls Long Term Cost and Capacity of Well**

That such small details as screen design should enter into consideration seems foolish to the average well user about to purchase a well. He is usually more interested in statements having to do with first cost of the well and production and if these are guaranteed so much the better. He does not realize that the one thing that has the most to do with the long term cost and capacity of his well is the screen in it. It has often been said (and rightly so) that "The screen is the heart of a well."

Selection of the proper screen is important because the number, size, shape and distribution of the water inlets of a screen control not only the capacity of a well but also determine the life of a well and the wear on pumping units. In many cases the openings used are too small and unnecessary entrance friction is set up which causes greater drawdown and greater pumping lift, increasing the cost of operation. On the other hand, if the openings are too large, the maximum amount of water will have free entrance into the well along with particles of silt, sand and small pebbles. In some cases where too large openings are used, sand may accumulate in the well in addition to that pumped out and there is always the danger, under these conditions, of forming a cavity around the screen which may result in a collapse and loss of the well.

How does the screen affect well capacity? In the first place the screen capacity must be sufficient to transmit into the well all the water the surrounding formation will yield without clogging or jamming. Screen capacity to transmit water and yielding capacity of a

formation are two different things and should not be confused. The openings in a screen can be likened to an orifice operating under a head in which case the hydraulic formulae governing flow through orifices govern. The flow of water through a permeable formation is an entirely different matter and while the same fundamental hydraulics apply, the flow of water through a formation is affected by many factors which are rather difficult to determine accurately, either in the field or laboratory.

Therefore, if a screen is not carefully selected it may or may not be capable of transmitting into a well the water available in a formation. It should be remembered that immediately a well is pumped, friction and velocity head are set up in the formation reducing the total hydrostatic head; further, that the capacity of the well (assuming the screen will transmit all the water that can get up to it) will depend on these friction losses, etc., which in turn vary with the velocity of flow through the formation. It is generally assumed that friction losses or head losses vary as the square of velocity. As applied to screens this means the larger the intake area of screen openings the less the velocity and friction through the screen and the greater the capacity.

#### **Shape of Screen Opening Most Important**

The shape of the screen openings is oftentimes considered of little importance. The fact is that the shape of the openings of a screen is one of the most important features, for if a screen is to function properly, it must not clog with sand or gravel, neither must it pass too much of the formation into the well. This means the openings should be V-shaped with the narrow opening next to the formation. If a particle of sand will pass this outer opening then it will pass through the entire opening as there are only two points of contact. In any type of square cut or straight side opening, a particle of sand must move the entire depth of the opening and is in contact with the opening until entirely passed into the well. There is every tendency to clog an opening of this kind. Furthermore screen openings should be continuous slots rather than an arrangement of individual or separate openings. Any regular shaped opening such as rectangle, square, circle, or oval is not of the best design as sand agains can easily lodge in such an opening and completely close it.

In addition to the screens using slots as openings, there are several other types of screens such as those where an opening is made in a

metal sheet by punching or raising portions of the metal above the sheet without removing any of the metal. These raised portions take the shape of squares, crosses, stars, rectangles, half circles, etc. and are known as "shutter type" screens. From the standpoint of design, openings created by punching without removing any metal have very little to commend them, as the opening must of necessity vary from a thin crack in the metal at the ends of the punch to whatever opening is desired in the center of the punch. Some screens of this type actually invite clogging and jamming as the punching simply tears the metal and the rough jagged edges soon start to corrode and incrust, eventually closing the entire opening.

Screens with clean cut perforations are to be preferred over punched openings for the openings will at least be full size with no sharp ragged edges to start clogging and corrosion. Experience has also shown that the original strength of the metal cannot be maintained after perforating or punching. Some manufacturers of this type of screen will not guarantee more than 80 per cent of the original strength of the metal under their own specifications. Experience has also shown that there is a difference in screens of this type in strength and performance depending upon the position of the long axis of the opening. The odds seem to be in favor of the long axis of the opening being horizontal and the spacing of horizontal rows not closer than two times the opening length and the vertical spacing not closer than two rows per inch. Symmetrical shaped openings such as crosses or stars should not be spaced closer than three times their long axis in both directions.

### **Larger Openings Now Used**

The widths of screen openings vary of course with the formation and method of well construction to be used. Where formerly an opening was used that would hold out from 60 to 80 per cent of the formation it is not uncommon nowadays to use an opening which will hold out from 30 to as low as 10 per cent of the formation, providing it is of mixed grading and high uniformity coefficient and gravel treatment either natural or artificial will be possible. It should be remembered that not all openings in screens will admit of development after installation as the methods of development are numerous and those that might be good for one shape of opening are positively harmful for a different shaped opening. It stands to reason that a screen with a continuous slot opening will have its intake area more

evenly divided over the screen surface and develop the water flow better than one having an uneven distribution of openings.

In connection with the shape and distribution of screen openings, the phenomenon of "bridging" should be recognized and understood. Bridging is that property of sand by which small particles may form a bridge or arch across the openings between larger particles or even over a screen opening and maintain the arch as long as the flow of water continues definitely in one direction. That bridging takes place and is a factor in determining the proper size and shape of openings in a screen has been recognized by screen manufacturers for some time. The writer has never heard of a rule whereby it can be determined when bridging will start in the formation sands.

### Results of Petroleum Industry Experiments

The petroleum industry has carried out some very elaborate experiments using several different shapes of openings to determine where bridging takes place in unconsolidated non-uniform sands as encountered in an oil well. Water bearing sands are generally mixtures, varying from free particles of mixed grading to cemented and compacted groups. In the petroleum industry it was found that the uniformity of the formation has a bearing on bridging and that the controlling factor or point where bridging takes place was in the vicinity of the 10 per cent point on a cumulative screen analysis. In other words where 10 per cent of the particles were coarser and 90 per cent finer. It was also found: (1) that bridges were formed by particles when their diameter was twice the diameter of rectangular or square openings and three times the diameter of circular openings; (2) that grain angularity and shape increase the range of bridging; (3) that the angle of repose cannot be relied upon to produce bridging if the sand is saturated with fluid; (4) that the included angle of screen openings must be at least  $2^\circ$  to avoid clogging; and (5) that slot openings must be approximately twice the diameter of the size of "bridging grain" for bridging to take place.

For many years there was no attempt on the part of screen manufacturers to standardize opening sizes. Each manufacturer made and designed the opening that appeared to be the best for his particular type of screen. This led to considerable confusion and misunderstanding among well drillers which gradually resulted in slot widths being designated in thousandths of an inch. On account of

the general use of gauze mesh numbers, equivalents were established as shown in table 1.

It is now common practice among well drillers and users to furnish the screen manufacturer with samples of the formation in which the screen is to be used. The size of slot opening is then selected on the basis of a sand analysis and the screen can be made with several different slot openings if necessary to properly screen the formation.

Of equal importance with area and shape of slot is the material used in making the screen. All ground water is more or less corrosive or incrusting depending on whether it is acid or alkaline chemically. Oftentimes the terms of corrosion and incrustation are confused and a considerable knowledge of chemistry and the electro-chemical theory of corrosion is necessary in order to understand properly these phe-

TABLE 1  
*Equivalents of Slot and Gauze Mesh Numbers*

SLOT NO.	GAUZE NO.	SLOT NO.	GAUZE NO.
6	90	35	20
7	80	50	12
8	70	70	8
10	60	100	$\frac{1}{10}$ inch
12	50	125	$\frac{1}{8}$ inch
18	40	187.5	$\frac{3}{16}$ inch
25	30	250	$\frac{1}{4}$ inch

nomena. They can be classified and referred to by the layman as a building up or depositing of material in the case of incrustation and a tearing down or removal of material in the case of corrosion. Corrosion, of course, is the more destructive as it destroys the screen while incrustation destroys the efficiency of the screen.

There are three general types of corrosion found in well screens—direct, selective and electrolytic. Direct corrosion is recognized by an even uniform destruction of the screen surface. Where this type of corrosion is encountered the slots will be enlarged but the screen will be intact and damaged only to the extent of the corrosion.

Selective corrosion is limited to certain alloys only. In this type of corrosion one or more of the metals of the alloy is changed or removed, leaving it in a soft spongy condition. This type is sometimes called dezincification or graphitization. Changing the alloy being used is about the only solution for this type. Iron and zinc

are especially subject to graphitization when used in conjunction with higher type metals.

Electrolytic corrosion is often encountered in well screens and is best explained by the electro-chemical theory. This theory is based on the fact that all metals have a tendency to go into solution in water. They cannot do this, however, without displacing some other element already in solution. Water being the most common compound found with this type of corrosion and containing hydrogen and oxygen, all metals are rated for their tendencies to go into solution using hydrogen as the base or zero. McKay and Worthington use the rating, as given in table 2, which is built on actual experience with corrosion and laboratory measurement.

Metals grouped together in this rating have no strong tendency to produce electrolytic corrosion on each other; connecting two metals separated from each other on the list tends to corrode the one highest (or first) in the list. The chromium irons and chromium-nickel-irons change position as they appear in the list depending on oxidizing conditions, acidity and chloride in solution. The series is correct for common dilute water solutions, weak acids, and alkalies.

The common materials used in metal well screens are graded for resistance to corrosion (the most resistant being first listed) by the leading metallurgists substantially as follows:

1. Monel Metal (approx. 70% nickel; 30% copper)
2. Super-Nickel (nickel 30%; copper 70%)
3. Everdur Metal (copper 96%; silicon 3%; manganese 1%)
4. Stainless Steel (low carbon steel 74%; chromium 18%; nickel 8%)
5. Silicon Red Brass (copper 83%; zinc 16%; silicon 1%)
6. Anaconda Red Brass (copper 85%; zinc 15%)
7. Toncan Iron (iron 99.55%; copper 0.4%; molybdenum 0.05%)
8. Armeo Iron (99.84% pure iron)
9. Steel (low carbon)
10. Ordinary Iron (cast)

Corrosion is commonly considered as being due to the ionization or concentration of acidity or alkalinity of the water. Carbon dioxide is always destructive when present in large quantities. Oxygen alone will cause considerable corrosion in acid, neutral and slightly alkaline water. In natural waters the rate of corrosion is directly proportional to the oxygen concentration, other factors remaining the same. Corrosion in acid solutions is much more rapid than in neutral solu-

tions and more rapid in neutral than in alkaline solutions. An important principle of corrosion in connection with well screens is that the rate of corrosion tends to increase with an increase in velocity of the water over the metal surface being corroded.

It is apparent that no metal or alloy has been developed as yet that will completely resist corrosion. Some have greater corrosion resistance than others but the perfect metal like the perfect man has not been discovered to date. In selecting a well screen it is almost essential to have a sample of the water to be pumped, analysed for its corrosive or incrusting tendencies before the proper metal to use can be selected. Ordinary chemical analyses seldom are sufficient. To make all the determinations necessary special analyses must be

TABLE 2  
*Rating of Corrosion Tendencies of Metals*

1. Magnesium (corroded end of series—Anodic)	11. Nickel
2. Aluminum	12. Brasses
3. Zinc	13. Bronzes
4. Cadmium	14. Nickel-Copper-Alloys
5. Iron	15. Copper
6. Chromium Iron (active)	16. Chromium Iron (passive)
7. Chromium-Nickel-Iron (active)	17. Chromium-Nickel-Iron (passive)
8. Solder	18. Silver
9. Tin	19. Gold
10. Lead	20. Platinum (protected end of series—Cathodic)

used which will disclose the activity factor of acidity or alkalinity. It is well to remember that a sample of water from a test well is often-times misleading and should not be used for analysis until the test well has been operated for a sufficient length of time to allow the water to reach its real chemical balance.

Incrustation as commonly encountered is caused by two conditions or a combination of both:

1. Direct mechanical incrustation due to materials carried in suspension in the water.
2. Incrustation due to precipitation of materials carried in solution in the water.

The chief incrusting agent is calcium carbonate (lime) which serves to cement the particles in the formation together and also to deposit on the screen. This type of incrustation will frequently build up a

wall several inches thick around a well screen and even extend several inches into a formation.

It is safe to say that, in nine cases out of ten, incrustation is of the second type, i.e., incrustation resulting from the precipitation of materials carried in solution in the water. In most of these cases there is little or no organic material present and as stated, the chief incrusting agent is calcium carbonate or lime. Sometimes aluminum silicate, iron and sulfates are found as contributing agents. While the calcium carbonate comprises a relatively small percentage of the total incrustation, it is usually the basic binder or cementing agent. For this reason it is important to consider why it is deposited at the well screen and how this depositing action may be reduced to a minimum by retarding or preventing the action.

All ground water contains more or less free carbon dioxide, which is a gas absorbed by water when it falls as rain and as it seeps through the ground. The capacity of water to absorb and hold carbon dioxide depends upon temperature and pressure. The colder the water and the greater the pressure, the more gas the water will absorb and hold. The combination of carbon dioxide gas with water forms carbonic acid which is a very weak acid. Pure water as it moves through the ground can absorb only a small amount of calcium carbonate into solution, but when the water contains carbon dioxide gas it can absorb considerable amounts of calcium carbonate and similar incrusting materials.

#### **Drawdown Causes Incrustation**

When water is pumped from a well the water level lowers, reducing the pressure head in the water-bearing formation because velocity head and friction are set up when the water is in motion. Because the pressure head is reduced, more or less of the carbon dioxide gas in the water is released and the water is unable to carry the load of incrusting materials. Consequently these materials are precipitated or dropped from the water and deposited where the pressure head is the lowest, which is at the well end or screen. The greatest amounts of incrusting material are deposited at or near the screen and in the formation around the screen.

The question naturally arises, "How can this be prevented?" In most cases it cannot be prevented entirely, but it can be delayed so that the trouble can be made less serious. From the cause as explained previously it is obvious that the thing to do is to keep the

drawdown or reduction of pressure head just as low as possible. This is accomplished in three ways.

First, the well must be finished with a screen which will permit the water to enter the well with the least resistance and which will permit the well to be developed thoroughly.

Second, the pumping rate may be reduced and pumping period increased.

Third, the pumping load may be divided between a larger number of wells of smaller diameter. The increased capacity of large wells over small wells is not nearly in proportion to the increase in diameter. Furthermore the proper spacing of smaller diameter wells will often reduce the trouble from incrustation by lessening drawdown in each well.

Considerable information has been gathered on the subject of reclaiming screens that have become incrustated, and many drillers have developed a technique for acid treating, back blowing, surging or otherwise restoring wells that have fallen off in capacity. The procedure is not always the same nor are the results, as these depend upon the cause and severity of the conditions, the skill of the operator and his knowledge of the ground formations. It is sufficient to say that it is now common practice to select well screens constructed of metals that will not only resist corrosion but will be adapted to acid treatment without injury.

It is not contended here that the average well user or well driller should be a chemist or an engineer, but it has been my purpose to try to point out a few of the factors entering into the design and manufacture of well screens and give every one interested the benefit of thirty-five years experience in manufacturing well screens, and trying to be of service to well drillers and well users.



## Air-Trapped Water Supply Mains

*By C. E. Elmendorf*

A GRAVITY water supply main is usually well behaved. It needs so little maintenance and gives so little difficulty that, although it is one of the most essential parts of a system, it is often forgotten. When it is new it usually operates well and it may be years before it is heard from again. It is one of the things that the superintendent frequently crosses off his list of worries for with a gravity system most of the headaches come from treatment or distribution. Once in a while the supply main, particularly if it has been long neglected, misbehaves and then the superintendent has a first class headache.

With plenty of water in the reservoir or other source of supply, pressure in the distribution system may start to drop for no apparent reason. Sometimes the drop is gradual and at other times it happens over night. The pressure keeps on dropping until there is little or no water available for distribution. This is an indication of air-trapping.

Usually when such an acute condition occurs, something has happened to the supply main to produce it. It may have been a leak, a stoppage, a temporary shutting off of the flow or an unusual and abnormal draft. Almost anything to upset the equilibrium of a poorly designed, constructed or maintained supply main may cause air trapping and the loss of flow and pressure. The majority of cases of such trouble occur on supply mains which have been built for years, and when constructed little if any attention was given to the laying of the pipe with relation to the hydraulic gradient.

A few years ago we were retained by a village having a water system that had been constructed about 35 years. The source of water

A paper presented at the New York Section meeting at Rochester, New York, March 31, 1939, by C. E. Elmendorf, Vice President, W. S. Lozier, Inc., Consulting Engineers, Rochester, N. Y.

supply was from springs about 5 miles away, some 140 feet above the village and 12 feet above the water surface in the service reservoir. We were told that the supply main had never operated satisfactorily as a gravity line and that the year after the system was built a pump was installed at the springs. For 34 years water was pumped down hill to the village. This pumping had been carried on so long that, when we were retained to correct the trouble with the main, there was considerable skepticism as to whether it could be done.

The conditions we found were briefly as follows: from the springs for a distance of about 3,500 ft. there was only about a 10-foot fall, and for the first 2,000 ft. the land was nearly level. From the point about 3,500 ft. distant from the springs on to the village there was good grade except for two minor summits over which the pipe was laid.

#### **System Studied after 34 Years of Pumping Down Hill**

When the system was first installed and put in operation the pipe for the first 2,000 ft. which was very unevenly laid must have become air bound. Then air relief valves were evidently installed at two or three points. These doubtless emitted air at certain times, but as the hydraulic gradient fell below the pipe at certain other times of daily consumption, air was sucked in. It was never possible to get all of this air out because of conditions within the pipe, with the result that a pump was installed at the springs and the water pumped down hill to the village. Had the conditions been studied and corrected 34 years ago the yearly cost of pumping could have been saved.

The first thing to do to correct this trouble was to get data from which to work. Taps were placed in the pipe at frequent intervals over the 3,500-foot stretch and elsewhere along the line. Accurate elevation data were taken, by gage readings, on these taps from which the exact line of the hydraulic gradient was determined. At points where very low pressures existed, they were determined by use of a hose, elevating the free end until it was actually on the hydraulic gradient when its elevation was read. Where there was a negative pressure (the hydraulic gradient was below the pipe) its elevation was computed from measured flows from the supply main and a pre-determined coefficient for the pipe. From data thus obtained a hydraulic gradient for the maximum daily demand of the village was computed.

The cure of the trouble and the elimination of the pumping was

simple but expensive. It was necessary to re-lay the entire upper section of the line to an accurate grade parallel to and below the maximum hydraulic gradient. The pipe was all laid to grade from grade stakes similar to those used in sewer construction. After the work was completed and the newly laid line put in service, the pump was stopped. The problem had been simply solved but, to many, the miraculous had been accomplished.

Another incident of air trapping of a supply main is vividly illustrated by a village which recently gave us an emergency call. The village had had a serious fire which drew the water in the standpipe in the village down to a very low level. When the fire was over and the standpipe should have filled up, the superintendent noticed that the level continued to decline.

The supply main was several miles long with air valves in brick manholes at the summits. The main led from the impounding dam and filter plant to the village and standpipe.

It was found that the air valves had not been serviced in many years and that they were not operating properly. The events which led to the air trapping of this supply main were: The lowering of the water level in the standpipe (due to the fire) brought the hydraulic gradient below the pipe line at the high points. Near one of these high points, close to the upper end of the line, a farmer was permitted to have a connection to the pipe. As far as he was concerned, water was free, so he left the faucet open all the time. When the heavy draft reduced the pressure at this point to zero and below, the hydraulic gradient fell below the pipe, air entered the faucet and flowed upstream in the pipe filling the high points. The air relief valves at the high points did not operate, with the result that the supply main was air trapped, in this case causing a complete shut off.

A study of conditions was made, the air relief valves located and opened, and the faucet closed. As soon as the line was freed of air by proper venting, the flow was again resumed. New relief valves were installed with instruction for them to be periodically inspected and serviced.

The major causes of air trapping of supply mains are:

1. Locating a pipe where the hydraulic gradient falls below the pipe for any interval of time.
2. Careless grading of pipe at critical points where the grade is very flat.
3. Lack of air relief valves and proper maintenance of same.

In cases of trouble we have found that the lack of accurate location maps and monuments locating the main has caused serious delay in finding and correcting the trouble.

When and if supply main troubles come, the best thing to do is to call the doctor—any experienced hydraulic engineer. To illustrate this statement let me cite a rather amusing engagement which we had with another village.

This village had a gravity system with a supply main about five miles in length. They had been having trouble with a leaky line and inability to fill their service reservoir at the village. An engineer was not deemed necessary. To solve their shortage problem they decided to drill wells near the supply. This was done but little or no water was obtained in any of the wells. Dry weather came on and one morning I received a call saying the reservoir was dry and that I should come down at once.

Upon my arrival I was told that when drilling the wells a workman had plugged the end of one of the lateral pipes to one of the wells with a bag; that the bag had gone down the pipe and into the supply main; and that it had shut off the flow of water. Could we at once locate the bag? Of course, an engineer will tackle anything, so we took the job.

We started in by having a series of taps put in the main for the purpose of obtaining data to plot the hydraulic gradient. The taps placed on the upper section of the main sucked in air indicating a negative pressure, the opposite of what would be expected with a stoppage in the pipe. Residual pressure readings were taken at each tap, also a series of static readings was taken with the main shut off.

When these data were all obtained, they were plotted. Instead of the static reading showing a level line, we had a uniform gradient to a tap near the village, then the line became level. This condition at once indicated a leak between this tap and the next one above, a distance of about 500 ft. We then ordered more holes dug and taps made between the two to locate the leak.

When the first hole, which we had located was being dug, the man heard water running. We were then told very excitedly by the superintendent that they had found the trouble. It was "the" leak. When the joint from which most of the lead blown out had been repaired, the reservoir filled. We never heard any more about the bag. The doctor had cured the patient, even though it was not the disease the patient thought he had.



## Legal Aspects of Damages Occurring from Leaks

*By Philip Burgess*

A SEARCH of the literature available and, particularly, in publications of the American Water Works Association, has disclosed the fact that but little, if anything, has been published relating to this subject. Furthermore, a discussion with associates and acquaintances engaged in constructing and operating water works properties has revealed that they have, at best, a very hazy idea of the responsibility of water works departments in connection with damage from leaks. I have not attempted to write a brief on the subject—I have only attempted to present some of the more important aspects of the subject which have developed from reading of relative cases and from discussion with some of my legal, and other, friends.

In the first place, it may be stated that the question of legal responsibility for damages resulting from leaks from water distribution systems constructed and maintained by municipal water departments involves, first, consideration of the question as to whether or not the operation of a water department is a "governmental" or a "proprietary" function. The law is clearly established in Ohio that municipalities are not liable in the absence of statutes while engaged in a governmental function. The great weight of authority in Ohio is that a city is liable for negligence of its employees for the reason that the operation of water departments by the cities of the state has been considered a proprietary function. Cases which have been tried in Ohio seem to agree that a municipal corporation maintaining a water supply system in the absence of negligence on the part of its agents or servants is not liable for damages caused by water escaping from its pipes.

One of the older cases is that of the City of Cincinnati vs. Renner (Ref. Ohio Circuit Court, vol. 33, p. 9). In this case, a woman broke

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A paper presented at the Ohio Section Meeting at Dayton, Ohio, April 27, 1939, by Philip Burgess, Consulting Engineer, Columbus, Ohio.

her leg on ice which had formed on water which had escaped from a leak in a water pipe in a Cincinnati street. The evidence disclosed that the water department used every effort to stop the leak as soon as possible. The Court in this case made the following statement:

"The Supreme Court of Ohio has quoted with approval the following from Wharton: 'Negligence' Section 869, 'When the legislature has sanctioned and authorized the use of a particular thing and it is used for the purpose for which it was authorized and every precaution has been observed to prevent injury, the sanction of the legislature carries with it this consequence, that if damage results from the use of such thing independently of negligence, the party using it is not responsible.'"

The Circuit Court stated further: "The legislature authorized the City of Cincinnati to construct and maintain water pipes in the streets of the City and it can only be answerable in damages for their construction and maintenance by reason of some negligent act committed or omitted." The Court found no negligence and no damage on the part of the City.

#### **The Law and Damages from Pipes Breaking**

The important features of the law with respect to damage from breakage of pipe lines would seem to be as follows: That if damage results from leaks, the party using the pipe, that is, the city water department, is not responsible provided the installation of the pipe line has been made under proper authority and provided that every precaution has been observed to prevent injury, and provided there has been no negligence on the part of the water department.

It may be argued that the operation of a municipal water department is necessary to the health, welfare and sanitary conditions of the city and that courts should determine that the operation of a municipal water department is a governmental function. It is quite possible that the reason that the courts have determined that the operation of a municipal water works department is a proprietary function, and not a governmental function, is that the courts have followed early decisions which were rendered at a time when furnishing water was not so necessary to the health, welfare, sanitation and safety of the public. However, as the law now stands, it has been determined that the operation of a municipal water department and the construction of water mains and water lines is a

proprietary function and the city is, therefore, liable for the proper construction, maintenance and operation of its water works system.

It is further obvious that, in the case of a private water company, there can be no question but that the operation of such a water corporation is a proprietary function and that, in the event of damage from leaks, the water company is always responsible in the event that negligence is proven.

The fact that, in some instances, water service is rendered by a private corporation has probably helped to sustain the findings of the courts that the operation of a municipal water department is a proprietary function, notwithstanding the fact that one service of a water department, namely, that of providing public fire protection, is not a proprietary but a governmental function.

A similar situation exists with respect to the operation of a municipal power and light plant where the municipality provides street lighting as a governmental function and electric power for domestic and commercial use as a proprietary function. Mr. John Davies, City Attorney of Columbus, Ohio, has advised the speaker of a recent case where a truck belonging to the municipal light and power department of the City of Columbus was involved in an accident resulting in damages which the City had to pay notwithstanding the fact that the truck at the time of the accident was engaged in repairing the street lights which the City claimed was a governmental function.

### **Employee's Negligence Renders City Liable**

It seems very clear, therefore, that a city water department is liable for damage resulting from leaks in the event that negligence is proven on the part of a city employee or agent. However, the question of negligence is a very broad one and involves many subjects. For example, beginning with the construction of the pipe system of the water department, in order to avoid negligence, it is necessary that the city do those things which should be done and do not leave undone those things which should be done. In order to avoid negligence, it is necessary that the City obtain proper materials and install them in a proper and satisfactory manner all in accordance with recognized sound practice. Carelessness in the selection of materials or in the installation of a pipe line may properly be construed as negligence.

Negligence may result not only during construction but also by neglecting to protect the installation after it has been completed. An interesting case was discussed in the Official Circular of the British Water Works Association for October, 1938, entitled "John Groves and Sons and another v. Weymouth Water Works Company." (King's Bench Div., Dorset Summer Assizes, Finlay, J. The Shirehall, Dorchester, 11th June, 1938.) In this case, water flowing from a burst water pipe damaged an adjacent basement. The court found for the defendant for the reason that no negligence was proven. In reviewing the case, Mr. Justice Finlay states that "the law, of course, is thoroughly well settled on this point. The authority that used, certainly, always to be referred to, and I suppose still is, is the case of *Green v. Chelsea Waterworks*, which is reported in the 70th volume of the *Law Times Reports*. That makes it perfectly clear that the only basis of such an action as this is negligence. The plaintiff has got to establish that the company did something which they ought not to have done or failed to do something which they ought to have done."

#### English Law Is Like Ohio Law

In this respect, therefore, the English and the Ohio law are the same with respect to a case where damage results from a leak and where a pipe line has been constructed under proper authority. Negligence must be proven as the only basis of an action for damages.

In discussing this case, Mr. Justice Finlay states further with respect to the need that the pipe be properly constructed as follows: "I am disposed to go with Mr. Cook as far as this, that if he had been in a position, which he was not, to establish that the concrete was there when the pipe was laid and that the pipe was laid with part of it on concrete and then another part on soft earth, that, I think, would be—it might be met, of course—at least some evidence of negligence on the ground which I indicated a few minutes ago, that the company are bound not merely to provide a good pipe but to lay it in a competent and skilful way.

"I think that if that is right, the only way in which the plaintiff's case could possibly be put is to say that there is evidence of negligence on this ground, that the defendants, if they had notice that this work was being done, ought to have interfered and said that concrete must not be laid down so as to affect their pipe. I should be disposed to go this far; I should be prepared to say that if notice is given to the

company and if, accordingly they, acting on the notice see that concrete is being laid down so as to affect their waterpipe, they would then be bound to interfere, because a thing which might dangerously affect their pipe was being done. I should assent to that."

The above principle of law is of interest and is quite far reaching for the reason that it puts the burden of responsibility upon a water department to see that its pipe lines are not endangered by others. In other words, the water department properly should interfere in the event that another party is building any structure or is interfering with its pipe line in such a way as to endanger the safety of the line. It naturally follows that, if a water department does not so protect its interests, and has notice of the event, then it may be negligent.

### Water Must Be Shut Off Promptly

Another form of negligence may be found if the city does not act promptly in shutting off water in the event of a break in a pipe line. Mr. Arthur E. Griffith, Assistant Director of Law of the City of Cleveland, has advised me of a recent case wherein the George Worthington Company sued the City of Cleveland for damages to materials stored in its cellar on account of breakage in a water pipe in the city street. (Court of Appeals No. 15501 and Supreme Court 26248.) The George Worthington Company recovered a judgment in the sum of \$5,184.36 which was stipulated as the amount of damages sustained by the reason the water damaged material in the basement of their building. The judgment was affirmed in the Court of Appeals and a Motion to Certify was overruled by the Supreme Court. It was conceded in this case that the operation of a water department by a municipality was a proprietary function.

The evidence in the case showed that the break occurred at approximately 8:20 P.M. and the water was not completely shut off until approximately 11:30 P.M.

From this case, it would appear that the court found that the City was negligent, not in the matter of construction, but that it did not show proper diligence in shutting off the flow of water. Diligence is the doing things in the proper time. Ordinary negligence is the want of ordinary diligence—which is that degree of diligence which men of ordinary prudence exercise in respect to their own concerns.

### Adequacy of Valves and Maintenance a Question

This case raises the question as to whether a city may be negligent in the event that it does not provide valves at proper intervals, does not maintain such valves in proper operating condition and, particularly, in the case of a large city does not maintain at all times an adequate maintenance force ready to shut off water, repair breaks and stop leaks. Otherwise, it is conceivable that a break of a large water pipe in the congested section of a large city might prove very costly.

An interesting case is that of the City of Cincinnati vs. Jacob. (Superior Court of Cincinnati, General Term, June, 1877.) In the report of this case, it is cited that "Where injury to property stored in a building was caused by flow of water into the street and thence into the building, from the defective service pipe leading from the main water pipe to another building on the street, which defective pipe had been placed in the street by the owner of the last named building by permission and under the supervision of the city authorities, for the purpose of supplying the last named building with water provided by the city: HELD, That after notice that water was escaping from the street into the building, the city authorities were bound to use reasonable care to prevent the continuance of the injury."

The leak occurred in the service line to another building and not to the building where the damage occurred. Furthermore, it was located near the main line between the main and the curb, in the street. The city claimed that the owner of the service line was responsible but the court did not so find. It found that water was escaping, not from the pipe line, but from the street into the plaintiff's cellar and if the city chose to permit the water to continue to flow into the street from the pipe it was at least their duty to use reasonable care to keep it out of plaintiff's premises. Leakage from the service had continued for sometime and the city was negligent in not stopping the flow of water after notice and full opportunity had been given. The finding of the court was based upon the principle that one may not allow water to accumulate on his property and thence escape onto the property of another.

Mr. Arthur Burnie, Vice President of the Beaver Valley Water Company, has told me of an interesting situation which arose at Beaver Falls, Pennsylvania. It seems that in 1929 this Company laid an 8-inch pipe on Eighth Avenue. A gas service pipe ran across

the ditch to a house located on the corner of Sixteenth Street and Eighth Avenue. In 1930, this house was seriously damaged by an explosion as the result of which the Manufacturers Light and Heat Company and the Beaver Valley Water Company were jointly sued by the owners who finally received \$11,500 of which the Water Company paid 35 per cent, or \$4,025.

The plaintiffs alleged that through negligence of the Beaver Valley Water Company, the ditch settled and broke the gas pipe and that gas leaking from this service line followed the gas trench into the house. Mr. Burnie never believed this was the case but, on the advice of attorneys, the Water Company settled the claim as above stated.

I believe that a situation of this nature could be avoided. The Water Company properly should give notice to the Gas Company when it encountered a gas service during the laying of a water pipe and the Water Company should request the Gas Company to inspect the gas service line until it is covered in the Water Company's trench. I believe that this procedure would place the responsibility for the maintenance and inspection of the gas line upon the Gas Company, where it rightfully belongs. I would strongly recommend this procedure when a gas pipe is encountered during the construction of a water line.

#### Summary of Factors Constituting Diligence

Summarizing all of the above, under the present law of Ohio, I believe that in order to avoid negligence and the possible payments of damage claims from leaks, a city must construct its water pipe lines in a proper manner in accordance with the best practice, must protect its lines against damage by others, and must be diligent in shutting off the water in case of a break in the lines. Shut-off valves must be provided and a maintenance gang kept available at all times, especially in large cities.

All of the above discussion has related to the subject of leaks from a water pipe and involves the question of property damage but seldom involves the question of personal injury. Another class of leaks, namely, those into a water pipe may cause no property damage but, on the contrary, may cause pollution of a public water supply and involve serious personal injury through sickness or death.

The importance of leaks of this class is clearly indicated in the very valuable paper entitled "Water Borne Outbreaks in the United

States and Canada and their Significance" by Gorman and Wolman (*Jour. A. W. W. A.*, **31**: 225). Table 10, "Major Causes of Outbreaks and Illness in Order of Magnitude" contained in this paper (page 307) shows that two of the most frequent causes of the pollution of public water supplies are cross-connections with polluted water supplies and seepage of surface water or sewage into a gravity conduit.

So much has been written on the subject of cross-connections that it would be superfluous to discuss them any further here. With reference to the importance of leakage into gravity conduits, it is only necessary to note that the most serious typhoid epidemic experienced in Ohio occurred some years ago at Salem and was caused by sewage leaking from a sanitary sewer into the collecting system of the public water supply. History records many incidences of serious epidemics caused by leaks of similar character and effect.

#### **Siphonage Is a Danger**

There is another possible source of danger not very well understood by the average water works operator and that is the danger from siphonage from a plumbing fixture into a distribution system. Not the least frequent offenders in this respect are the flushometer type of fixtures which are coming into common use, particularly, in family-group buildings and in hotels. Unless properly protected, a flushometer may be a real source of danger to a public water supply because its outlet may be submerged in the fixture. In a high building, a particularly dangerous situation may exist because of reduced pressures in the supply line and the liability of a vacuum existing in the supply to the fixture.

Another frequent source of pollution is the ordinary bath tub. This can be demonstrated by filling the tub with water to the top of the overflow and coloring the water in the tub. Then if the supply to the building is shut off and a fixture opened in the basement, the water from the tub will flow out of the fixture in the basement unless the supply faucet in the bath tube is properly located.

A recent inspection of plumbing installations and water supply cross-connections in a city having about 15,000 active water services disclosed 955 pollution points, nearly one-half of which were in residences and apartment houses. Bacterial tests indicated that, at times, the water contained in certain sections of the distribution

system of the above city was contaminated by leakage into the mains from the customer's plumbing fixtures.

In "The Valve World" of October, 1936, Mr. R. H. Zinkil describes tests which he conducted to determine the safe air gaps required to prevent back siphonage from plumbing fixtures. He recommends the minimum safe air gaps as given in table 1.

For some types of installations, it is important that the water supply line, and particularly for large buildings such as apartment houses and hotels, be adequate and that vacuum-breaking devices be provided.

It will readily be appreciated that the legal aspect of damages from leaks of the above character is an interesting and important subject. Each case should be considered upon its own merits. Prob-

TABLE 1

DIAM. OF OPENING	MINIMUM SAFE AIR GAP
<i>inches</i>	<i>inches</i>
0.127	0.34
0.187	0.44
0.227	0.52
0.403	0.81
0.570	1.03
0.806	1.44

ably the general law of negligence applies in pretty much the same way as it applies in case of damage resulting from water flowing from leaks upon adjacent property. However, I am of the opinion that, in view of the importance of the subject and of the personal injury factor, the courts may soon look upon damages involving personal injury in a somewhat different manner. That is, it is coming to be realized that a water department is required at all times to furnish a wholesome water supply and if it is proven that sickness or injury results from the pollution of a public water supply, we may expect to have a claim for damage on the part of the injured consumer, regardless of negligence on the part of the water works management. In other words, I feel that we may be approaching the status of "*Res Ipsa Loquitur*" which in ordinary English means "the thing speaks for itself." Possibly the best way to explain this legal

tenet will be to quote from 29 Ohio Jurisprudence, page 631-632, as follows:

"Sec. 153. While it may be true that the mere fact of injury will not give rise to a presumption of negligence on the part of any one, it is also true that some accompanying elemental facts have long been deemed to be sufficient proof of negligence to establish a *prima facie* case in favor of a person maintaining an action therefore. The doctrine of *res ipsa loquitur* asserts that whenever a thing which produced an injury is shown to have been under the control and management of the defendant, and the occurrence is such as in the ordinary course of events does not happen if due care has been exercised, the fact of injury itself will be deemed to afford sufficient or reasonable evidence to support a recovery, in the absence of any explanation by the defendant tending to show that the injury was not due to his want of care. The expression '*res ipsa loquitur*' literally means 'the thing speaks for itself.' The doctrine of *res ipsa loquitur* is regarded as a qualification of the rule that negligence is not presumed or inferred from the mere fact of injury. The doctrine applies only where, on proof of the occurrence and the injury, the existence of negligent default is the more reasonable probability, and it should not be allowed to prevail where, on proof of the occurrence, without more, the matter rests only in conjecture."

#### **Proof of Negligence May Not Be Necessary**

In other words, we may be approaching the situation such that, if a public water supply becomes polluted and causes disease among the consumers, it may not be necessary to prove negligence in order to sustain damages on the part of the water department. So much information is now available in the water works literature that ignorance of proper construction and maintenance of a water property offers no excuse.

Ignorance of the law of negligence also will not protect a water works department in case of damage from breaks. In view of this situation, I can recommend to the members of this Association and to other water works operators that it is very important that they inform themselves of their duties in connection with the construction, operation and maintenance of their properties and the necessity for protecting others from damage.

**Discussion By W. Victor Weir.\*** Mr. Burgess has performed a valuable service to the water works fraternity by analysing the legal aspects surrounding damage suits filed because of leaks and the damages resulting from them.

His findings in regard to Ohio law apply in general in Missouri, as they will elsewhere in this country. There seems to be only one municipal water department service which may come under the category of governmental function, i.e., fire hydrant service.

#### Authoritative Suit Described

An interesting and authoritative suit took place in Missouri a few years ago in the case of *Lober v. Kansas City (Mo.)*. This case is reviewed in the *South Western Reporter*, 74 (2d) page 815 and covers practically every phase of the legal aspects. I recommend it as very interesting reading.

In brief, two street department employees were using a fire hydrant at night to flush debris from a street in the business section of Kansas City. In closing the hydrant, one workman gave the hydrant key an extra yank to make it close tightly and buckled the stem. The pressure forced open the valve and water discharged from the steamer opening clear across the street and into a window of a basement printing shop owned by Lober. The street department men called the water department and two men were on the job in ten minutes. These men tried to close the gate valve on the hydrant lead but the force of the water washed them away. They then tried to locate the valves at the corners of the adjacent streets, but were unable to find them. Finally the water department truck was backed across the stream of water from the hydrant so as to break its force. A workman then succeeded in reaching the gate valve and closed it. The hydrant had discharged water into the printing establishment for over an hour, completely inundating everything.

When this suit was heard by the Circuit Court of Jackson County, the plaintiff was awarded \$25,000 on the basis that negligence was evident and under Missouri law the operation of the hydrant was for the purpose of keeping the streets in a safe and suitable condition for travel and use, and was within the city's corporate rather than its governmental capacity.

On appeal, the Supreme Court of Missouri reversed the Circuit

\* Superintendent, St. Louis Water Company, University City, Missouri.

Court on the ground that the operation of the hydrant was for the purpose of keeping the streets sanitary and healthful, which was a governmental function and that, although negligence was evident, the City was not liable.

In the course of the State Supreme Court decision there appear the following statements:

"A city owning and operating water systems for both the proprietary purpose of supplying its inhabitants with water for revenue and the governmental purpose of preventing fires and keeping the city sanitary and healthful is liable for damage caused by defects in or lack of repair of water mains or other appliances used concurrently in both capacities."

"Municipalities are liable for injury caused by the negligence of an employee in flushing hydrants, if the flushing is incident to its regular water service, but not if incident to its fire department service."

"*Res ipsa loquitur* doctrine applies when (a) the occurrence causing injury to plaintiff was such as does not ordinarily happen if those in charge use due care, (b) instrumentalities involved were under the defendant's management and control, and (c) defendant possessed superior knowledge or means of information as to cause of occurrence."

The Missouri courts held the *res ipsa loquitur* doctrine to apply in the case cited.

#### Doubtful Immunity in Governmental Function

The line demarking governmental and proprietary functions is so extremely thin and volatile that a water superintendent had better place no reliance in the water department's immunity where fire hydrant service is concerned. As long as hydrants are used only for fire protection and street cleaning as a health measure, the immunity may exist. Should the hydrants be used to flush out mains or as the source of water for sidewalk and street construction, a court might hold that no immunity exists.

Whenever a damage suit is filed, the superintendent is asked for a report of the facts surrounding the occurrence and repair of the leak. Since suits are often filed months after a leak occurred and sometimes when no damage was evident, the superintendent's report is often an embarrassing collection of guesses. Therefore records of all leaks should be made. This record should show who

reported the leak and when, the time the flow of water was stopped, the cause of the leak, the condition of the pipe, where the escaping water went, whether or not any damage was evident and to what extent, the names of all department employees who worked at the scene of the leak, and the names of other witnesses. These records should be filed for future reference since claims for subsidence of foundations, injury to other underground structures, etc. may not be made for months or even years. Such claims may be groundless, but the chance of collecting is good if the department has no record of exactly what occurred at the time of the leak.

In every damage suit, the plaintiff tries to prove negligence while the water utility tries to prove diligence and due care in regard to construction and maintenance of the pipe and in closing valves to stop the flow of water. It behooves every water superintendent to realize that practices regarded yesterday as diligent may today or tomorrow be evidences of negligence.

#### **Diligence Defined by Standard Practices**

In court a practice is measured as diligent or negligent by whether it is or is not accepted in the field of water works practice. If a main is constructed of materials meeting American Water Works Association or Federal specifications, and is installed according to the A. W. W. A. Standard Specifications for Laying Cast-Iron Pipe, then it is difficult to prove negligence in construction. Should unapproved materials be used and the installation specifications be lax, the plaintiff will have little trouble in proving that ordinary care was not used. If a crew gets to a leak in reasonable time and closes the gate valves with dispatch, such action will be termed diligent. Should the crew have to phone or go to the office for valve measurements, this loss of time might not today constitute negligence. However, the publication by the American Water Works Association of a standard practice regarding the keeping of distribution system records which provides that valve location records be carried on maintenance trucks may cause a court to find this loss of time to constitute negligence. The development of a standard practice in regard to record keeping is now actively under way by an A. W. W. A. Committee.

When accepted standards have been set up for materials, methods of making installations, methods of preventing or minimizing accidents, or methods of operating procedure, then every superintendent

should examine his practices in the light of these standard methods. If his practices are different from or inferior to those outlined in standard practices now published by the A. W. W. A., or some other recognized body, he had better pray that the plaintiff's lawyer does not find that such standard practices exist. It will require much expert testimony to offset the weight of a published standard of practice.

A prudent superintendent will know of all the published standards of practice and will follow these standards to the letter, excepting where local conditions or accepted improvements warrant deviations. He is, of course, responsible for and will be able to defend any such deviations which may exist in procedures in his water department.



## Administrative Problems of Preventing and Correcting Defective Plumbing

*By A. H. Fletcher*

**P**ROTECTION of the drinking water supply of a city involves not only control of the source and treatment but also protection throughout the entire distribution system. Such protection should include, first of all, control of direct cross-connections between public and quasi-public water supplies and other non-potable water supplies. In addition, protection should also be afforded these drinking water supplies as they are piped within buildings to tanks, cooling equipment, chemical vats, swimming pools, for priming pumps or other building equipment and to toilet bowls, urinals, sinks, cellar drainers, grease traps, instrument and water sterilizers, dish washers, laboratory sinks, bed-pan washers and other such fixtures and equipment located in individual rooms throughout the building. A public drinking water supply of a city may include many inter-connected quasi-public water supplies which must be considered as a part of the complete drinking water system of that city.

To date, so far as is known, a program which will completely cope with this problem is not being carried out by any city in the United States. A few cities have taken only the first step in providing a safe public water supply and are content with a sort of "f.o.b. pumping station" attitude, which offers a protected supply only at its source or after treatment. Others have gone beyond this and have searched out and eliminated all dangerous direct cross-connections with unsafe industrial supplies, and have developed control programs for protecting any quasi-public water supplies both as to source, treatment and cross-connection with non-potable supplies. Some few have gone still farther by protecting both public and quasi-

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A paper presented at the Kentucky-Tennessee Section meeting at Memphis, Tennessee, April 11, 1939, by A. H. Fletcher, Sanitary Engineer, Department of Health, Memphis, Tenn.

public drinking water supplies in buildings and on private premises against direct connections to open and otherwise unprotected and unsafe tanks, chemical vats, swimming pools, etc. Few cities, however, have set in motion a complete protection program which includes all of these features and, in addition, the control of plumbing as it affects the safety of the drinking water supply. Several cities have made good starts on this final step and are leading the way with the help of independent research projects in developing fundamental principles and standards. Their work is stimulating others to follow.

The subject of this paper is the last or final step in the complete control program outlined above, namely, that of controlling cross-connections through plumbing fixtures and the complimentary problem of the hydraulic design of piping, particularly in buildings, to minimize the creation of negative pressures.

Gorman and Wolman, in their recent paper<sup>1</sup> on water-borne outbreaks in the United States and Canada, have furnished a great deal of valuable data regarding the need of complete protection programs. Five of the 33 large outbreaks in the United States in which 300 or more persons were affected were caused by cross-connections with polluted water supplies. One of the conclusions in the Gorman and Wolman paper which is particularly applicable to the discussion in this paper is that "During this period many large and disastrous water-borne outbreaks occurred."

A number of plumbing investigations and studies have been made in different cities during the past few years. Many potentially dangerous conditions have been uncovered which indicate the possibility that defective or incorrectly installed plumbing has been, or could be, responsible for the pollution of water supplies. One of the most striking situations in which faulty plumbing is rather generally found is in hospitals, where the maximum of care to prevent infection is necessary.

Figure 1 pictures diagrammatically how suction might be created on a riser pipe in a tall building. The contents of the toilet bowl on the upper floors would be drawn into the water line to mix with drinking water going to a fountain on a lower floor. This figure indicates the amount of suction that would be created if measured by a gage under ideal conditions as shown for creating the maximum suction.

Until a few years ago there was a definite trend for a decade or

<sup>1</sup> Jour. A. W. W. A., 31: 225 (1939).

more towards the removal of plumbing inspection from health departments. As the modern science of bacteriology developed and the old theory of disease transmission by sewer gas was scientifically

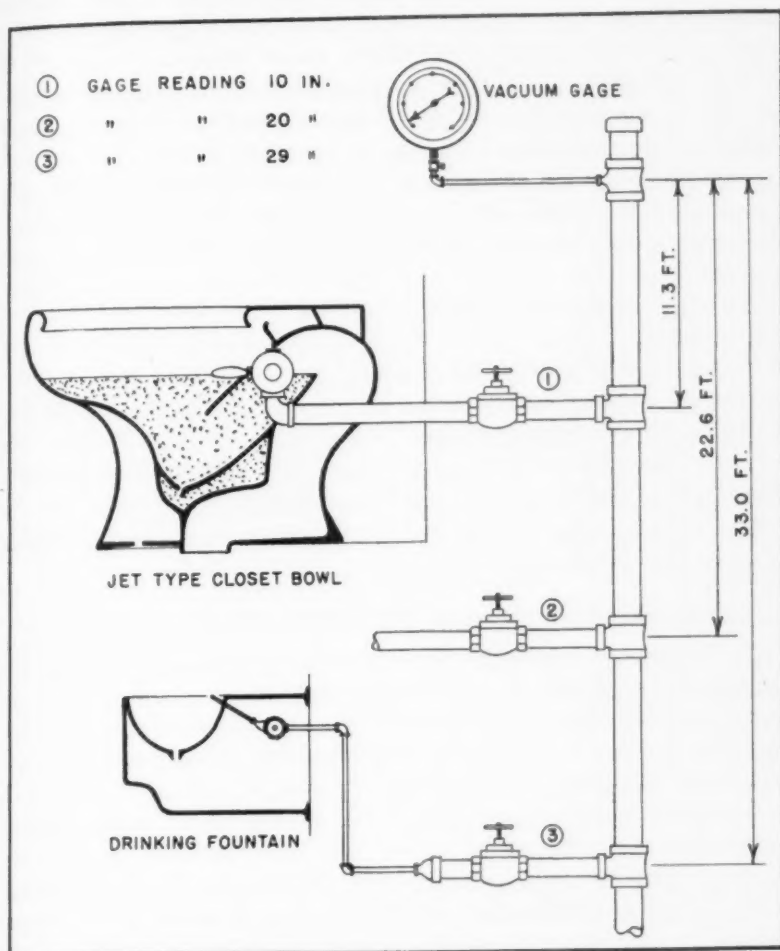


FIG. 1. How Suction May Be Created in a Tall Building

discredited, the mental reaction of sanitarians was to limit plumbing supervision to nuisance prevention and protection against property damage.

Today, many sanitarians feel that health and water departments

should again become interested in plumbing because of the dangers of back siphonage. To safeguard against this danger regulations and inspection must be provided in order to prevent back siphonage from toilets, sterilizers, sinks, air-conditioning equipment, condensers, swimming pools, etc., into the water lines supplying these fixtures and equipment.

The final step in a complete water supply protection program calls for the development of protective devices against back siphonage and proper hydraulic design of water piping and fixtures. The very nature of these problems suggests the need of engineering study and consultation service in relation to control regulations and activities. Such a program to be most effective should include the following five general steps:

1. Cooperative effort of the water, plumbing and health departments.
2. A survey of piping and plumbing fixtures in buildings.
3. A plumbing ordinance or an amendment in order to include the control of water piping and type of fixture.
4. An adequate correctional program by qualified personnel and direction based on a new ordinance and code.
5. An educational program to secure necessary cooperation and support from all interested groups and departments.

#### **Municipal Departments Should Divide Responsibility**

Each department interested should be asked to assume the responsibility for some specific phase or phases of the complete control program. It is easily seen that cooperation of the various departments is essential to the success of a well planned coordinated study, enforcement and educational program on safe plumbing.

The plumbing inspector will see the program largely from a practical working and inspection viewpoint. He might be expected to be responsible for the granting of permits and approving of plumbing work installed. He would certainly be best able to secure the cooperation of plumbers and plumbing concerns, especially in the matter of cooperating with the construction of a testing and demonstrating laboratory if built.

The water department will see the program as an effort to protect the public water supply. It can cooperate by granting permits for connections to city mains only to licensed plumbers. If a demonstration laboratory is required, the water department might be best able to provide the space.

The health department will see the program as one to protect all drinking water supplies, whether public or quasi-public. It may be called on to interpret the ordinance when a matter of public health is in question. It might also be required to approve the piping plans for buildings. In any retroactive effort to correct existing conditions, the health department would probably be in the best position to do effective work. The health department can also contribute in the general educational and demonstration phase of a program.

A survey of existing piping and plumbing fixtures in buildings, with special reference to health hazards of back siphonage, should be designed to cover all the problems involved. An attempt is, therefore, made to outline these and to indicate how the data may be secured.

A detailed study of existing installations to enable a practical intelligent analysis of existing dangers to correct the most dangerous conditions is necessary in each case. In most cases the correction will be the installation of some back-siphonage prevention device on the offending fixture and the elimination of direct connections to waste lines or unapproved equipment, tanks, etc. It may be possible at times to correct the piping sizes for certain sections and relieve the condition of excessive friction head loss.

### Steps of Complete Survey

A complete picture of the piping and fixtures in each building being studied should be the objective of the survey forms developed. The data obtained should permit an evaluation of the degree of hazard existing in each building surveyed. The procedure followed in a number of recent surveys has been:

1. A floor plan is made of each floor, showing all the plumbing fixtures. A detailed check of each fixture to determine whether it is approved or not is then made. The ratings of these individual fixtures are averaged for each type of fixture for the entire building.

2. The city or main line is then traced to the various branches such as drinking line, private system, house supply system, fire and sprinkler system, line to tanks or treatment equipment, lines to boilers, etc.

3. Bacterial analysis of samples from various points in the system are taken.

4. General information is gathered regarding all waste lines from fixtures, floor drains, etc.

5. Information is obtained concerning the various stacks, vents,

drains, ejectors, sumps, etc., which are parts of the waste water system. Special checks are made on laboratory, hospital and some industrial plant equipment.

The report forms are designed to secure all data considered necessary and worthwhile in order to evaluate properly the problem and to enable recommendations to be made, but no unnecessary information or detail that would not be used is contained in the report. This outline follows closely the forms used in recent surveys made in Chicago, Baltimore, New York and Detroit.

### **Effective Plumbing Ordinance Needed**

The third step pictured in this problem of control is an up-to-date written program which should be adopted by the city in the form of an ordinance and code. Bringing a plumbing ordinance up to date will include additions to the existing ordinance of some general requirements controlling the design of water piping and fixtures. It will also include new requirements for the licensing of plumbers who have shown through examination and school work, if necessary, that they are qualified to carry on plumbing work and do understand the public health hazards involved in plumbing.

All important phases of the plumbing program should be included in the fundamental basis on which the licenses are awarded. Plumbers should be prepared to interpret the plumbing ordinance not only as to the existing specifications for materials, sizes, traps, vents, distance, etc., but to recognize dangerous water connections, unapproved fixtures, and the necessity of proper piping capacity to minimize the creation of partial vacuums.

The recommended minimum requirements for plumbing as published by the Bureau of Standards and the reports of various committees on plumbing of national organizations should be consulted in preparing a new ordinance. It will be necessary to settle the matter of what part each of the interested departments will be responsible for in the enforcement of the ordinance. There are problems of hydraulics, cross-connections, licensing and control of plumbers, fixture design, issuance of permits, inspection of work, and condemnation of existing plumbing and replacing of same, etc. This ordinance will then serve as a statement (as to the requirements) for satisfactory plumbing and will be the foundation on which the correctional and educational programs are built.

The preparation of a sound correctional program based on the new

ordinance, when adopted, and on the conditions uncovered in the survey must then be made and agreed on. The degree of the hazards uncovered will, of course, influence the points at which the correction program will first be aimed.

A correctional program must have, as one of its phases, an adequate inspection service in order to control the type of plumbing and fixtures which go into all new buildings, or into new installations or remodeling of existing installations. The present set-up may be too small really to control plumbing work. If the sole underlying purpose of plumbing inspection is to prevent nuisances and to save property owners money, it might be hard to justify a large inspection service and the tendency might be to get by with as little as possible. If, however, the protection of the public's health by preventing connections with sewage and waste systems permitting back-siphonage into a drinking water supply is added to the present purpose of a plumbing ordinance, then there is probably justification for a larger corps of inspectors.

The second phase of a correctional program is the survey of existing buildings in order to evaluate the potential hazard in each building and to require the correction of the most hazardous conditions. This phase of the program can possibly be best carried on by the health department, and, of course, with the close cooperation of the water department and plumbing inspection program. In this program each individual problem will have to be studied in order to balance the cost of the changes against the seriousness of the hazard to be corrected. In other words, the practical would have to be considered along with the theoretical.

#### **Practical Devices Needed for Education**

An educational and control program should make use of as many practical devices as possible to inform plumbers and interested officials, as well as the lay public, of the dangers of faulty plumbing and of the necessity for complete and adequate control.

The problem of preventing contamination of water through plumbing defects involves both material things such as fixtures and the more intangible human equation. Properly designed fixtures, adequate pipe sizes, and well trained plumbers to install them are equally necessary.

The educational program may require a laboratory, even though small, which can be used for both testing fixtures and conditions in

pipings which affect siphonage, as well as for demonstrating to the plumbers and the lay public the various fixtures and the fundamental principles involved in creating unsafe conditions.

Such a program should be developed advisedly and conservatively so as to get results without developing a feeling of distrust or fear on the part of the lay public that an emergency exists or that the public and quasi-public water supplies are not safe.

### Summary

1. Few, if any cities in the United States can claim, in the light of present day knowledge, to be protecting adequately their complete drinking water supply.

2. During the seventeen year period from 1920 through 1936, 125,000 persons are known to have contracted illness as a result of almost 500 water-borne epidemics resulting in approximately 1,200 deaths. One of the major causes of these outbreaks was cross-connections.

3. The final step of a complete water protection program might be considered the control of indirect cross-connections through plumbing fixtures.

4. Fundamental requirements for complete separation of the water supply from toilets are outlined in the 1938-39 American Public Health Association Year Book.

5. A sound enforcement plumbing program should be based on facts and should be developed only after considerable thought and planning. The cooperation of the several parties concerned is essential to success.

6. Such a program to be successful should include a survey of conditions in buildings and the drafting of an ordinance and code.

7. Five steps are outlined as necessary in developing a plumbing control program and should be taken in order.

8. After the decision is made to initiate such a program, it may take several years to build and develop it into a smooth working unit.



## Cross-Connection Elimination in Nashville

By Robert L. Lawrence, Jr.

THERE is probably not a single person who is reading this paper who is not familiar with the term "cross-connection." There is no operator of a water works system who would deliberately permit the existence of a condition within the system under his supervision which would in any way set up a menace to public health. If you were asked whether you have any cross-connections in your system, the chances are that most of you would reply, we do not; and you would mean by this reply that to your knowledge no permission had been given to a consumer to make a connection between your supply and any other supply, and that if such permission was asked you would flatly refuse it. But, on the other hand, it would be very doubtful whether you would have any specific municipal regulations to back you up; and further, it would be very doubtful whether you have kept a systematic check of your system to see if any cross-connections had crept in over a period of years. You would probably sit back and tell your questioners that you have no cross-connections because you had never given anyone permission to make one; and that you do not believe anyone would do such a foolish thing knowing the possible consequences of contaminating the public water supply.

But there is where you are wrong. I suspect that there are many cross-connections which are potential sources of epidemics in existence in very many systems.

From the foregoing statements you might gather the impression that I am speaking a little too boldly, but when I tell you our experience in Nashville you will understand, as I suspect, that some of your experiences might not be far different from ours.

A paper presented at the Kentucky-Tennessee Section meeting at Memphis, Tennessee, April 11, 1939, by Robert L. Lawrence, Jr., Supt. and Chief Engineer, Nashville Water Dept., Nashville, Tennessee.

In connection with our own system we had exactly the experience outlined above with the exception that we were fortunate enough to wake up before we had any trouble. Up until August, 1933 we were sure that there were no dangerous connections between our supply and any private supplies. But in August, 1933 the City Health Officer's attention was called to several cases of typhoid fever among the employees of a large paper board company. He made a survey of the situation and asked us to take samples of the drinking water and make a survey ourselves. We found that this plant was using a private supply of raw water from the Cumberland River for preparing wood pulp; and that the workmen who stood around the pulp mixing vats had their hands contaminated badly with the polluted water which had been polluted by the sewage discharge from the city. The health officials found that the workmen would frequently eat their food without even washing their hands. We also found that there was in existence a cross-connection between the city's supply to this plant and the raw water supply mentioned above, the two supplies being separated only by a closed gate valve.

#### **Polluted Water on Both Sides of Valve**

The department bacteriologist was instructed to take bacteriological samples from both sides of the closed gate valve; and although there was a 85-pound pressure on the city side as compared with 75 lb. on the raw water or private supply side, the water was found to be polluted on both sides of the closed valve.

Fortunately, in the case under discussion, the drinking fountain from which the workmen obtained their drinking water was far removed from the point of connection between the city's supply and the private supply; and many tests proved that the closest point of pollution of the city supply within the plant was far removed from the source of drinking water. The health officials were absolutely satisfied that the few cases of typhoid fever were attributable to the contamination of the workmen's hands by the raw water used in mixing the wood pulp.

After the disclosures in the foregoing case were made, one of our service installation inspectors was instructed to make a complete survey and a detailed examination of the complicated piping systems within all of our large industrial plants, most of which are located along the Cumberland River below the points of sewage discharge from the city.

We were aided in making this survey by being able to obtain complete and accurate plans of most of these piping systems from the Tennessee Inspection Bureau which has a record of the piping system within the premises of plants carrying insurance. Complete files have been kept on this survey showing in detail the portion of a system used for the private supply and the portion used for the municipal supply.

We found many cross-connections, some of which were potentially ugly and some of which were just technically cross-connections. I wish to take the opportunity here to state that connections which are ideal from the viewpoint of a plant engineer in the operation of his plant may be, potentially, sources of great danger and a menace to public health.

Who would blame a plant engineer, provided he had no knowledge of the possible consequences, if, in order to insure the uninterrupted operation of his plant, he should make a piping connection to the boilers so that by only opening and closing two or three valves he could switch from the city supply to the private supply, or vice versa? That was exactly what we found in many cases. Most of the cross-connections had been made after the original installation of the city water supply; and they had been made by plant operators for the purpose of making their plant operation more flexible and in many instances to improve their fire protection.

#### Examples of Cross-Connections Given

In order that we may get an idea of some of the different types of cross-connections that are possible, I will enumerate some which we have encountered during the course of our survey and which are included in our files. One has already been referred to because the discovery of it was responsible for making the Nashville Department cross-connection minded. Another tough proposition to handle involved the fire protection of a large chemical manufacturing plant.

The layout of this plant was as follows: There was a 6-inch connection entering this plant which took care of both the industrial and fire demand. This plant also had a separate raw water supply for cooling water and for fire protection. On this raw water line were located fire pumps which might have built the pressure up above the city pressure; and the city supply line was found to be tied into the system into which raw water could have been pumped in order that, in case of failure of the private supply, water from the

city supply could have flowed in under the normal city pressure. It is perfectly obvious that that was an ideal arrangement for the consumer as he was provided with a dual fire supply. Also this was an ideal arrangement from the Fire Insurance Underwriters' standpoint who are always pleased with additional fire fighting facilities. But from the standpoint of the promotion of public health this condition was not so good. Of course the two supplies were separated by two bronze check valves with a test connection in between to test for leakage. But whoever saw a check valve or two check valves that did not leak after operating for a short while; and hadn't we already found by actual tests of our own that bacteria could and would pass from one side of a closed valve to the other?

In view of these facts it became necessary for us to direct this large consumer to destroy all physical connection between his private supply and the city supply.

This was not as simple as it might appear. The destroying of the cross-connection would greatly change the status of the plant's fire insurance rating; and this could have been offset only by the installation of greatly increased storage facilities; the Fire Underwriters specified an additional elevated tank which would have cost in the neighborhood of \$10,000. The prospect of such a large expenditure right out of a clear sky caused this company to meet us with this reply: "We are now paying you over \$300 per month for water and if it should become necessary for us to rearrange our entire system at such an enormous expense, we might as well consider the treatment of our own water and using our private supply for all of our needs."

Well, a \$300 per month consumer is one which, ordinarily, none of us would have been desirous of losing but the management of this large plant was answered as follows:

"We are, quite naturally, desirous of continuing to serve you and are reluctant to have you discontinue the use of city water. However, the matter of public health is a problem of vital importance to this community; therefore, we have no other alternative than to require the removal or elimination of any condition which might be inconsistent with our policy of furthering the public health program."

Fortunately, the final solution of this problem was simpler than it had seemed at first. The city, at the time this matter came up, had only a 6-inch main available to this company's property. This

main was not considered adequate to furnish full fire protection to so large a plant; and that was the principal reason that the plant had installed a private supply: to augment the city supply. Each supply had to depend upon the other; and that was the reason the Fire Underwriters required additional storage facilities: to make the private supply adequate in case the city supply was discontinued. But some time prior to this matter the water works department had set up a program of projects which included the installation of a new 12-inch trunk main in front of the chemical plant. When this fact was put before the Underwriters, the entire complexion of things was changed. It was found that with the additional city supply the cross-connection might be destroyed without increasing the insurance rate or augmenting the storage facilities for the private supply.

The final solution was this: The consumer was permitted to maintain the private supply until the new and larger main was installed, provided that the connecting or closure piece was to be removed between the two supplies; and that the water works department would be notified immediately in case the connection should be restored in order that we might make the proper bacteriological tests and perform the necessary sterilization of the mains.

#### Stored Supply Is a Source of Contamination

Another type of connection was found in the course of our survey where there was no other source of supply for the premises except the city supply, but the city water was stored in large uncovered reservoirs for fire purposes. The fire pumps took their suction from these reservoirs and built up a pressure greater than the city pressure in the fire lines which were also connected to the city supply and only separated by a check valve which would have permitted the city supply to flow in under normal pressure in case of failure of the fire pumps.

You can see that the water stored in these open reservoirs for months and months was subjected to gross contamination; and it would have never done for this water to have found its way back into the city supply.

This type of connection might be corrected by either of two methods. The reservoir might be covered in an approved manner or the physical connection might be destroyed between the lines

carrying the recirculated water and the supply line direct from the city main; and the city supply then spilled into the uncovered reservoir at a point at least 12 inches above the reservoir overflow level.

Cross-connections were also discovered at several of the large ice plants which maintain private wells for supplying cooling water for their condensers and cooling coils. These supplies were found to be connected to the pipes carrying the city supply in order that emergency cut-overs might be made in case of failure of the private supply. Cross-connections were also found in suburban residences between spring, well and cistern supplies.

Private and public swimming pools were found in many instances, to be potential sources of contamination, particularly where the supply line fed into a pool below the water level or fed directly into the suction of the circulating pump in connection with a filtering system. The two types of connections just mentioned are dangerous because of the possibility of polluted water being syphoned back into the city mains due to the development of a negative pressure in the city system which might be caused by a sudden break in a main.

#### **Procedure in Securing Eliminations**

Now, back to the general procedure that was followed in eliminating the existing cross-connections which were found by our survey:

As had been previously stated, when the matter of cross-connections was brought to our attention by the cases of typhoid fever which developed among employees of one of our large industrial plants, the water department began a very comprehensive survey of all of the large industrial plants, particularly those along the Cumberland River, then, those large establishments which were known or found to have private well supplies such as ice plants and large department stores and theatres with air-conditioning systems. After the large connections were destroyed we then began combing the system for miscellaneous connections that might have been potential sources of danger.

Of course you realize that we encountered some very complicated piping layouts within the consumers' premises, but inasmuch as most all of the large plants carry fire insurance, we were able to obtain plans of these systems from the Tennessee Inspection Bureau which information helped us very much by saving a great deal of time and work as it became necessary for us only to trace out the underwriter's plans and make only minor changes or corrections.

A complete file has been kept on every consumer where cross-connections were found, these files including a layout of the system showing where the connections were eliminated, copies of bacteriological tests and all of the correspondence between the department and the consumer on the subject of cross-connections.

The bacteriological reports were on samples taken from each side of the dividing valves between the city supply and the private supply and I would like to interrupt here to state that we were extremely fortunate in not finding a single source of drinking water that was contaminated, although we found many cross-connections.

After we had located the different connections, our next worry was to eliminate them. We had no city ordinance prohibiting cross-connections so we consulted the State Department of Health to find out if there was in existence a State statute to back us up. There was no such statute, but the State Department of Health had a full set of suggested regulations for municipalities for use as a guide in formulating local ordinances; and the State Department very kindly offered to coöperate with us by verifying to the consumer our claim that all cross-connections should be eliminated.

After carefully deliberating over this matter, we decided that the best policy to follow would be to try to obtain the destruction of all connections by appealing to the consumer's sense of duty to his employees and to the community instead of rushing in and having an ordinance passed to be used as a club to eliminate a condition which we might have been somewhat negligent in not recognizing earlier ourselves. Therefore, as cross-connections were discovered, notices were sent to consumers on whose premises cross-connections were found in the form of a letter, a typical example of which is shown on the following page.

A copy of each letter was sent to the City Health Officer and to the member of the Board of Public Works in charge of the Water Works Department.

Usually upon receipt of the notice from the Department the consumer would contact us for further details which we gladly furnished with a view of helping him work out his problem properly. I am pleased to state that every connection was destroyed, most of them promptly, without any drastic threats upon the part of the water works department.

We also took the opportunity of educating the City Health Department in the importance of helping us to detect and eliminate

*Typical Letter*

————— Chemical Company  
Nashville, Tennessee

Gentlemen:

Upon making a complete examination of your inside water-piping system, we found that you have several cross-connections between your raw untreated private supply and the city supply.

The existence of any physical connection between pipes transporting the city supply and a private supply is never permitted by the Water Department where the existence of such connection is known because of the chance of the city supply becoming contaminated from the untreated private supply.

There are records of epidemics which have been traceable to such connections. Therefore, this is to notify you that you must destroy immediately any physical connection that might exist between your private supply and the supply of the City Water Department.

Thanking you for your immediate coöperation, I am  
Yours very truly,

Superintendent and Chief Engineer  
Water Works Dept.

any possible sources of contamination or pollution of the water in the distribution system after it had left our plant in a highly potable state.

**Need for Ordinance Felt**

After elimination was accomplished we became of the opinion that there should be drawn, very carefully and fully, an ordinance which in the future would regulate this particular problem in water distribution. Consequently, after very careful and mature deliberation the writer drafted the following ordinance. It was enacted into law by the City Council March 6, 1934 upon the recommendation of the Mayor and Board of Public Works and is known as Ordinance No. 900 of the City of Nashville, regulating connections between the city water supply and any other source of supply:

BE IT ENACTED BY THE MAYOR AND CITY COUNCIL  
OF NASHVILLE:

SECTION 1. That it shall be unlawful for any person, firm or corporation to cause a connection to be made, or to allow one to exist, for any purpose whatsoever, between the city water supply and any other source of supply; or to cause a connection to be made, or allow one to exist, between the city water supply and any piping system transporting water from any source of supply whatsoever, and which has been subjected to contamination by storage in an insanitary container such as uncovered and improperly constructed pools, reservoirs, storage tanks and standpipes; and city supply lines discharging into improperly constructed and uncovered pools, reservoirs, storage tanks, standpipes and insanitary containers of any kind in which the water therein stored is subjected to contamination must discharge into said pools, reservoirs, storage tanks, standpipes, and insanitary containers in such a manner as to prevent syphoning back of the water therein stored into the city supply line in case of the development of a negative pressure in the city supply lines.

SEC. 2. That pools, reservoirs, storage tanks, standpipes and plans for pools, reservoirs, storage tanks, or any container in which water from the city water system is stored and from which the water therein stored is circulated through pipes connected to the city supply, must be approved by the Tennessee State Department of Public Health and the City Health Officer as to their sanitary condition and ability to adequately protect the water therein stored from contamination before final approval for their use is given by the Superintendent and Chief Engineer of the Water Works Department of the City of Nashville.

SEC. 3. That any person, firm or corporation whose premises are supplied with water from the city water supply system, and who also have on the same premises a separate source of supply or store water in insanitary pools, storage tanks, standpipes or any other insanitary container from which the water therein stored is circulated through a piping system, shall file with the Supt. and Chief Engineer of the Water Works Dept. of the City of Nashville a statement of the non-existence of cross connections.

SEC. 4. That any person, firm or corporation which now has cross connections in violation of the provisions of this ordinance shall be allowed a reasonable time within which to comply with the

provisions of this ordinance, such time to be designated by the Supt. and Chief Engineer of the Water Works Dept. of the City of Nashville.

SEC. 5. That any person, firm or corporation who neglects or refuses to comply with any of the provisions of this ordinance shall be deemed guilty of a misdemeanor and upon conviction therefor shall be fined not less than five (\$5.00) dollars, nor more than fifty (\$50.00) dollars. And the continued violation of any provision of this ordinance shall constitute a separate offence, for each and every day such violation of any provision hereof shall continue. And in addition to the foregoing fines and penalties the Supt. and Chief Engineer of the Water Works Dept. of the City of Nashville shall discontinue the city water service upon any premises upon which there is found to be a connection between the city water supply and another source of water supply, and upon any premises upon which there is found to be a connection between the city water supply and any piping system transporting water from any source of supply whatsoever and which has been subjected to contamination by storage in an insanitary container, such as uncovered and improperly constructed pools, reservoirs, storage tanks and standpipes, and such service shall not be restored until such cross connection has been discontinued.

SEC. 6. BE IT FURTHER ENACTED, That this ordinance shall take effect from and after its passage, the welfare of the city requiring it.



## Discussion on Plumbing Hazards

By A. R. McGonegal

THIS paper was originally presented as a discussion of "Plumbing Hazards and Their Evaluation," which was given by Arthur P. Miller at the Four States Section meeting, October 6, 1938, and published in the Journal of the American Water Works Association, October, 1938. Much credit should be given Mr. Miller and his coworkers for their study and determinations anent the findings of the survey of plumbing hazards in public buildings in New York and Detroit. I thoroughly agree with all that Mr. Miller has said relative to cross-connections and back siphonage, with the exception of the use of pressure in the method of compiling a value for hazards.

Of the factors which determine the hazard, the most indeterminate one is pressure. It is not necessary that a complete vacuum should occur but simply a drop in the hydraulic head of the supply. This may occur only occasionally during some unprecedented peak in usage but as time goes on and ferrous pipes become incrustated, this loss of hydraulic head will occur more frequently.

I can visualize an installation in a relatively high building that will work satisfactorily without diminution of pressures on the higher floors for many years, and then, owing to reduction in area of risers and possibly increase in usage on the lower floors, the supply might in time no longer reach the upper floors at all. One of the most serious causes of this condition, outside of the incrustation of the interior of pipes, is the constantly increasing usage of water cooled air-conditioning. For instance, otherwise non-air-conditioned buildings may have several stores on the ground floor, each of which installs a small system of its own, bleeding the normal supply to a point where the available street or pump pressure will not carry to the upper floors.

A discussion presented at the Four States Section meeting at Washington, D. C., October 6, 1938, by A. R. McGonegal, Chief Plumbing Inspector, Washington, D. C.

Certain room air-conditioning units contribute to this result. For this reason a supply under pressure on the top floor of a building when the installation and the piping is new may be an entirely different story after only a few years.

For this reason, the District of Columbia Inspection Division does not agree with the method of compiling a value for the hazards in any building based on the three elements Mr. Miller spoke of because one of the three elements, the water pressure, may and does vary from time to time and a building that is zero today may have a score tomorrow up in the hundreds.

We are one hundred per cent for protection against cross-connections and back siphonage.

#### **Water Department Shares Responsibility**

We feel more strongly than Mr. Miller about the responsibility for plumbing hazards inside of buildings (and outside of them for that matter). We feel that the water works people are just as much responsible as the plumbing inspection people. The reasons for this are two: In the first place, the water works officials agree to deliver potable water and if the water is polluted beyond the front wall of the building this fact should be known to them and they should take steps to see that the potable water actually reaches the people for whom it is intended. In the second place, there are hundreds of cities throughout the country that either have no plumbing inspection or sketchy plumbing inspection at best. The incumbents are frequently political and sometimes are not alert to duties of this kind. Even in the larger cities the plumbing inspection force is not generally of a professional class and is almost always short of personnel. Another matter which sometimes has a bearing is the fact that while the plumbing inspection division normally belongs under the health department, it frequently is a part of the building inspection division, the public safety division or some other division of the city government having no close connection with the water works officials.

Of interest may be a brief description of some of the problems in Washington and the District of Columbia. Washington has 66 hotels, 1,740 restaurants and beverage dispensing places, 22 hospitals, about 4,000 rooming houses and 240 manufacturies or places where food or beverage is prepared for sale to the public. This latter class includes candy factories, wholesale market establishments, one sausage factory, bakeries, ice cream plants, dairies, etc.

In the matter of restaurants and beverage establishments and food factories, a renewal of license\* will not be granted to these people yearly unless the plumbing inspection division shall certify that the plumbing is suitable and proper for the purpose. We find a good many cases where after an examination in October and November of one year the proprietor has had improper plumbing work done and not reported for inspection. This, of course, is ordered out and changed before a renewal license can be granted.

### Results of License Inspection Service

Before the advent of this license inspection service on these practically 2,000 units, they were the most prolific source of bootleg and improper plumbing that could possibly be conceived. We maintain two men constantly on this work.

It is interesting to know that just within the last few days we have unexpectedly found a large institution where there are 13 (unlucky number) positive inter-connections between public water supply mains and a questionable water supply from wells on the property. These inter-connections vary from 4 to 10 inches. We have been able to come to an agreement with them whereby these feeds from the District mains can be cut off with two exceptions and in these two cases the mains will feed up 35 ft. in the air and return down in a loop so that a vacuum in the mains cannot pull the well water supply.

We have corrected the water supply to some 26 swimming pools so that there is no physical connection whatever between the circulating lines, the filters, or whatnot. One trouble we have had is divorcing the chlorinating apparatus.

We have a complete list of wells in this jurisdiction and these are checked from time to time to see that there is no physical cross-connection installed.

Washington is exceptionally free of manufacturing establishments but such as are near the river or along side the Chesapeake and Ohio Canal are inspected from time to time and occasionally we find that some engineer or handy-man has installed a direct pressure pump primer or a direct pressure pump sealing ring since the previous inspection.

Appended to this brief discussion is a list of points where cross-connections are likely to occur. This list is distributed to the plumbing inspectors in mimeograph form by the Plumbing Inspection Division in Washington, D. C.

### Information Given to Plumbing Inspectors

Cross-connections may be found in any place where water under pressure is consumed or dispensed and there are sewers or wastes in the premises and/or separate water supplies from wells, rivers, canals, cisterns, etc. Surface wells are peculiarly subject to pollution and deep wells may become polluted over night.

The following numbered items are offered as possible geneses of these public and individual health hazards. Generally speaking, there should be no physical connection between a pipe carrying a potable water supply and a water supply which may become unpotable or a waste or sewer line.

1. Water closet bowls equipped with flushometer valves or with flushing tanks having submerged float operated ballcocks.
2. Frost-proof water closets, either with or without tanks, and whether or not the valve drains to the sewer as recommended by most manufacturers.
3. Hopper closets with hand operated flush valves.
4. Seat acting water closets with the flush valve in or attached to the bowl.
5. Bed pan washers.
6. Bidets.
7. Sterilizers with water inlets subject to pollution by either gravity or siphonic action.
8. Therapeutic baths with inlets below the rim of the fixture.
9. Water operated waste ejectors, such as are used by dentists, undertakers and those who practice colonic irrigation.
10. Cellar drainers of the water jet type.
11. Bathtubs with inlets below the rim of the fixture.
12. Wash basins with inlets below the rim of the fixture.
13. Drinking fountains with drinking orifice below the rim of the fixture. Special care should be taken that the pressure relief or any other orifice in the supply is not below the rim.
14. Glass washing and/or sterilizing apparatus usually seen in drug stores and beverage places.
15. Laundry trays with faucets below the rim.
16. Sinks with faucets or water inlets below the rim and sinks with loose hose connections not provided with a proper retractor.
17. Dishwashing sinks or machines with water inlets below the rim.
18. Cuspidors with water supply connections.
19. Dental cuspidors with water supply connections.

20. Hospital appliances generally, such as sterilizers, condensers, filters, stills, aspirators, etc. In the case of stills, sometimes the gage glass and connections remain polluted and may pollute the entire contents.

21. Combination faucets with one supply safe and the other unsafe.

22. Floor drains with water flush connection.

23. Swimming pools with water supply inlets below the overflow line or having a physical connection between potable water and the circulating mains.

24. Yard hydrants, arranged so that polluted ground water can drain into the water supply line.

25. Automatic water supplied siphon flush tanks with inlet below the water line. This includes public sewer flush tanks.

26. Dual water pumps operated from an unsafe water supply and pumping a safe supply.

27. Industrial vats, tanks, etc., of any description which have an inverted water supply connection, or a water supply connection below the top of the spill rim, or in which a host filler is used.

28. Industrial water supplied process appliances with direct water connections and without adequate air gaps.

29. A rubber hose with hand control or self-closing faucets attached, as used in connection with baths, industrial vats, tanneries, etc.

30. Pumpage pits with drains into cesspools, etc.

31. Leaking water mains and water services near sewers.

32. Any physical connection between pipes carrying safe and unsafe water.

33. In general, any type of water supply connection that permits the return of used water into the water supply system by drainage, siphonage or force.

34. Pressure water supplied sealing rings on sewage and sludge pumps.

35. Water supply to float valve in sewage plants.

36. Water supply for pump priming connections.

37. Water pressure sludge pipe blow-outs.

38. Water supply (hot or cold) to laundry wash wheels.

39. Water supply to laundry heat economizers.

40. Water supply to soap kettles in laundries.

41. Water supply to water jacketed grease intercepting traps with cast partitions.

42. Condenser cooling connections for refrigeration and air-conditioning machinery.
43. Drains from fire sprinklers connected direct to sewers or wastes.
44. Steam tables.
45. Sterilizers.
46. Condensers.
47. Fire hydrants draining direct to sewer.
48. Filters with the backwash directly connected to water supply.
49. Stills.
50. Aspirators.
51. Chlorinators.
52. Factory mutual double check on fire lines.

#### Where to Look for Types of Cross-Connections

The following listing shows where it is well to look for these possibilities of cross-connection or siphonage. Numbers refer to the location or situation in the above list.

*General:* 21-31-26-32-33-42-43-53.

*Household:* 1-2-3-6-10-11-12-15-16-17-24.

*Schools and Public Buildings in General:* 1-4-10-12-13-16-23-24-25-43-45-48.

*Physicians, Dentists and Undertakers:* 1-6-9-18-19-45-46-29-50.

*Hospitals:* 1-5-6-7-8-9-10-11-12-13-18-19-48-49-50-25-45-46-29-43-15.

*Restaurants:* 1-7-10-12-13-14-15-16-44-41-17.

*Swimming Pools:* 48-51-23.

*Sewage Disposal Plants:* 51-26-34-35-36-37-51.

*Refrigeration and Air-Conditioning:* 42-46.

*Manufacturies:* 1-9-12-13-16-27-28-26-29-34-36-43-48-51.

*Laundries:* 38-39-40-43-51.



## The Voges-Proskauer and Methyl Red Reactions in the Coli-aerogenes Group

By Reese Vaughn, N. B. Mitchell and Max Levine

PRIMARY differentiation of coli-aerogenes bacteria is at present generally made on the basis of the Voges-Proskauer reaction (V.P.), the methyl red test (M.R.), and Koser's citrate test (Cit.). Two genera have been recognized: *Escherichia* (M.R. +, V.P. -, Cit. -) and *Aerobacter* (M.R. -, V.P. +, Cit. +). The generic term *Citrobacter* has been suggested for strains whose characteristics do not conform strictly to either of the above genera and such strains are generally considered as constituting an "intermediate" group.

During routine examination of 169 strains of so-called "intermediate" coli-aerogenes bacteria which were used in connection with studies on hydrogen sulfide production in the colon group by Vaughn and Levine in 1936 (29), questionable or positive Voges-Proskauer reactions were encountered when certain cultures were grown in "Difco" MR-VP medium at 37°C. for 2 days and tested with 10 per cent KOH solution. Invariably these cultures exhibiting questionable or positive V.P. reactions were methyl red positive and grew in Koser's citrate medium. The writers were not convinced that these strains (M.R. +, V.P. + or ?, Cit. +) were properly allocated as belonging to the intermediate section. Ruchhoft, Kallas, Chinn and Coulter in 1931 (25) considered organisms with such a combination of reactions as being mixtures of *Aerobacter* with *Escherichia*, one of these genera with extraneous forms, or atypical strains. Werkman and Gillen in 1932 (30) placed certain M.R. +, V.P. + or ?, Cit. + strains in their proposed genus *Citrobacter* to which they also allocated organisms considered as typical intermediate colon strains, i.e. M.R. +, V.P. -, Cit. +. Koser in 1924 and 1926 (12, 13), Raghavachari in 1926 (24), Taylor et al. in 1926 (26),

A contributed record of research by Reese Vaughn, N. B. Mitchell, and Max Levine, Engineering Experiment Station and Dept. of Bacteriology, Iowa State College, Ames, Iowa. The authors wish to express their indebtedness to Jacob Coblentz for assistance in some of the experimental work.

Bardsley in 1926 and 1934 (3, 4), Hicks in 1927 (9), Minkewitsch in 1929 and 1930 (18, 19), Holwerda in 1930 (10), Pawan in 1931 (22), Burke-Gaffney in 1932 (6), Barritt in 1936 (5), Parr in 1938 (23) and others have reported strains for which the M.R. and V.P. tests did not correlate. Clark and Lubs in 1915 (8) designated an incubation temperature of 30°C. for a period of 5 days, for the methyl red test. Levine in 1916 (14, 15), Chen and Rettger in 1920 (7), Koser in 1923 (11) and others have reported that the incubation period and temperature were important factors in the determination of the V.P. and M.R. reactions. Linton in 1924 (17) noted the disappearance of the positive V.P. reaction in as short a time as 60 hours; Paine in 1927 (21) and Williams and Morrow in 1928 (31) reported the destruction of acetyl-methyl-carbinol by both *Escherichia* and *Aerobacter* strains and Tittsler in 1938 (27) has recently confirmed these investigations.

The *Standard Methods* of the American Public Health Association (3rd ed., 1917; 5th ed., 1923) specified an incubation temperature of 30°C. for a period of 5 days before completing the methyl red and Voges-Proskauer tests. Joint committees of the A. P. H. A. and the American Water Works Association (*Standard Methods*, 6th ed., 1925; 7th ed., 1933) recommended an incubation temperature of 37°C. for a period of 4 days before completing the V.P. and M.R. tests. This recommendation was modified in 1936 (*Standard Methods*, 8th ed.) when an incubation temperature of 37°C. for a period of 3 or preferably 4 days was specified for the M.R. test and a temperature of 37°C. with 24 to 48 hours incubation was recommended for the V.P. test.

Because of the significance generally attached to the correlation of the V.P. and M.R. tests as differential reactions for coli-aerogenes bacteria it was thought advisable further to investigate factors which might affect these reactions particularly with respect to the intermediate colon strains. Failure to adhere to proper temperature and periods of incubation probably accounts for many of the reports of intermediate colon strains.

In addition to 221 intermediates, which included strains isolated from human, animal and bird feces, rotted potatoes, shucked oysters, eggs, milk and water, well established strains of the genera *Escherichia* and *Aerobacter* were studied as controls.

The Difco dehydrated M.R.-V.P. medium was used throughout this investigation. The medium was prepared by dissolving in distilled water and dispensing 12 c.c. portions into test tubes, 20 mm.

in diameter by 150 mm. in length. The medium was sterilized at 15 pounds pressure for 15 minutes and immediately cooled. Heavy inoculations were made from 18 to 24 hour nutrient agar slant cultures of the test organisms.

The methyl red reaction is the resultant of the rates of acid production and acid utilization in a suitably buffered medium. Temperature markedly affects these rates and the reaction is a function of the period of incubation.

In table 1 are shown the results obtained with 221 presumably intermediate strains of the coli-aerogenes group tested in Difco M.R.-V.P. medium at 30° and 37°C. It will be noted that 35 strains produced an alkaline reaction in 2 days at 30°C. and this number rose to 37 after 5 days incubation, whereas at 37°C. there

TABLE 1

*Effect of Temperature and Period of Incubation on Methyl Red Reaction of 221 Intermediate Strains of Coli-Aerogenes Group*

TEMPERATURE OF INCUBATION	INCUBATION PERIOD (DAYS)			
	2	3	4	5
	Number of strains alkaline to Methyl Red			
°C.				
30	35	37	37	37
37	5	7	10	11

were but 5 strains which were negative for the M.R. reaction in 2 days and only 11 strains after 5 days incubation.

In a series of observations with 138 strains of pure cultures of *Aerobacter*, each of which was distinctly alkaline after 5 days at 30°C., it was found that 30 strains (21.7 per cent) were distinctly acid after 5 days at 41-43°C.

It is evident that the higher temperatures of incubation are conducive to increasing the number of apparently positive M.R. tests and if the strains produce acetyl-methyl-carbinol they would be erroneously allocated to the intermediate group.

#### Effect of Temperature, Incubation Period and Test Reagent

Each of the 221 test strains was inoculated into 10 tubes of the Difco medium, half of which were incubated at 30°C. and the remaining 5 tubes at 37°C. One tube from each set was examined

daily. The V.P. reaction was determined by three methods: (1) the so-called standard technique using equal portions of culture medium and 10 per cent KOH, (2) a modification of the O'Meara reagent (16) using equal volumes of culture and 0.3 per cent creatine in 40 per cent KOH solution, and (3) the  $\alpha$ -naphthol test of Barritt (5) using 1 c.c. of culture to which was added 0.6 c.c. of 5 per cent  $\alpha$ -naphthol in absolute ethyl alcohol and 0.2 c.c. of 40 per cent KOH. The results are shown in table 2 where it will be noted that the number of positive V.P. tests was distinctly greater at 30°C. than at 37°C. and that this was true for all periods of incubation and all test reagents. Furthermore, though the number of positive reactions

TABLE 2

*Effect of Temperature, Period of Incubation and Test Reagent on V.P. Reaction of 221 Intermediate Strains*

TEST REAGENT	DAYS INCUBATION				
	1	2	3	4	5
	Per cent positive at 30°C.				
10% KOH.....	20.4	21.7	21.7	21.7	21.3
Creatine-KOH.....	23.1	23.1	23.1	22.6	22.6
$\alpha$ -naphthol.....	23.1	23.1	23.1	23.1	23.1
	Per cent positive at 37°C.				
	1	2	3	4	5
	Per cent positive at 37°C.				
10% KOH.....	9.5	11.8	15.4	15.4	16.3
Creatine-KOH.....	17.2	19.0	19.5	19.5	19.9
$\alpha$ -naphthol.....	19.9	19.9	19.9	19.9	20.4

at 37°C. increased with the longer periods of incubation, they never equalled that obtained in 24 hours at 30°C.

That high incubation temperatures tend to reduce the number of positive V.P. reactions was also observed in a study of 138 strains of the genus *Aerobacter*. Each of these strains was positive for the V.P. test after 1 and 5 days at 30°C., but when incubated at 41-43°C. only 100 (72.5 per cent) strains were positive after one day and 88 (63.8 per cent) after 5 days incubation at the higher temperature.

For detection of acetyl-methyl-carbinol the lower temperature (30°C.) for 24 to 48 hours is preferable to 37°C., even with longer incubation periods. With the higher incubation temperature (37°C.) some strains, particularly of the genus *Aerobacter*, may be incorrectly considered as intermediate or "irregular" forms.

The extent to which temperature of incubation affected allocation of the 221 reputedly intermediate strains is illustrated in table 3 from which it will be noted that:

(1) The number of strains utilizing citric acid was not affected by the temperature or period of incubation,

(2) The number of typical *Escherichia* (M.R. +, V.P. -, Cit. -) was the same at both temperatures and periods of incubation.

(3) Of the 51 strains which were V.P. + at 30°C., 7 remained negative for 5 days at 37°C., while of 37 typical *Aerobacter* strains (V.P. +, Cit. +, M.R. -), all of which were M.R. - at 30°C., only 5 were negative after 2 days and but 11 after 5 days at 37°C. It appears therefore that due to the tendency of the high incubation

TABLE 3

*Effect of Temperature of Incubation on Allocation of 221 Strains of Coli-Aerogenes Group*

GROUP	INCUBATION DAYS			
	2		5	
	Incubation temp.			
	30°C.	37°C.	30°C.	37°C.
	Number of strains			
M.R.+, V.P.+, Cit.+	16	39	14	33
M.R.-, V.P.+, Cit.+	35	5	37	11
M.R.+, V.P.-, Cit.+	162	169	162	169
M.R.+, V.P.-, Cit.-	8	8	8	8

temperature (37°C.) to yield a larger number of M.R. + and V.P. - reactions, whereas the citrate test is not affected, strains of the genus *Aerobacter* are particularly likely to be improperly allocated as intermediate members of the coli-aerogenes group.

#### Speed of Development with Various Reagents

The selection of a reagent for routine use in determining the Voges-Proskauer reaction should be governed largely by its ease of preparation and sensitivity. The reaction should be distinct and rapid. The speed of development of the V.P. reaction when using the 10 per cent KOH, creatine-KOH, and  $\alpha$ -naphthol reagents was observed on strains known to produce acetyl-methyl-carbinol. The tests were carried out, as previously described, in Difco M.R.-V.P.

medium incubated at 37°C. for two days. The results are indicated in table 4.

The  $\alpha$ -naphthol reagent appreciably reduced the time required for detection of a positive V.P. test. All of the test strains were positive with the  $\alpha$ -naphthol reagent two hours after addition of the test reagents. Only 45.5 per cent of the strains gave positive reactions with 10 per cent KOH and 75.3 per cent were positive with the creatine-KOH solution in the same length of time. The relative speed of development of positive reactions is particularly well shown by the results obtained one-half hour after addition of the test reagents,

TABLE 4  
*Effect of Reagent on Rate of Development of Voges-Proskauer Reaction*

TIME ELAPSED†	TEST REAGENT		
	10% KOH	0.3% Creatine in 40% KOH	$\alpha$ -Naphthol
	% Positive reactions (198 strains)		
<i>hours</i>			
$\frac{1}{2}$	0.5	52.0	94.5
1	10.7	61.6	99.5
2	45.5	75.3	100.0
4	66.7	94.5	100.0
6	74.2	94.5	100.0
24	83.8	96.5	*

\* Not possible to make dependable observations 24 hours after addition of reagent.

† After addition of test reagent to 2 day 37°C. culture in Difco M.R.-V.P. medium.

when positive reactions were observed in 94.5 per cent of the tests with  $\alpha$ -naphthol, 52 per cent with creatine-KOH and only 0.5 per cent with the KOH reagent.

The crimson to ruby color signifying a positive  $\alpha$ -naphthol V.P. reaction becomes darkened to a brownish color which may turn very dark brown and form a dark precipitate or return to a coppery color characteristic of a negative  $\alpha$ -naphthol V.P. reaction when the culture is allowed to stand 24 hours after addition of the reagents. It is therefore necessary to record the reaction within a few hours.

The  $\alpha$ -naphthol V.P. reagent (5) is particularly desirable because

it is relatively simple, easy to use, more sensitive than the 10 per cent KOH reagent and the reaction is very distinct and appears quite rapidly (generally in less than an hour).

### Summary and Conclusions

When attempting to differentiate between bacteria of the coli-aerogenes group, it is necessary to investigate thoroughly the Voges-Proskauer and methyl red reactions before drawing definite conclusions as to the identity of cultures under observation.

The so-called intermediate coli-like bacteria are considered by most authors to have methyl red +, Voges-Proskauer -, and citrate + biochemical reactions. However, of 221 cultures received as intermediate coli-aerogenes bacteria (genus *Citrobacter*), only 162 (73.3 per cent) actually fulfilled these requirements whereas of the remaining 69 strains, 51 cultures (23.1 per cent) were considered as belonging to the genus *Aerobacter* and 8 strains (3.6 per cent) were considered to be members of the genus *Escherichia*. The above allocations were observed only when an incubation temperature of 30°C. was used in connection with Barritt's  $\alpha$ -naphthol modification of the V.P. test or the creatine KOH O'Meara reagent (as modified by Levine, Epstein and Vaughn). There was a very high negative correlation between the V.P. and M.R. reactions at 30°C., less marked at 37°C., but absolute correlation was not obtained at either temperature during the incubation periods employed. The citrate reactions were the same at 30° and 37°C.

The temperature and period of incubation are significant factors as respects the utilization of both the V.P. and M.R. reactions for primary differentiation of sections of the coli-aerogenes group of bacteria. On the basis of the observations herein recorded, a temperature of 30°C. appears desirable for use in connection with the V.P. and M.R. tests. Temperatures of 37°C. or 41-43°C. interfered with the production of positive V.P. reactions by organisms capable of producing acetyl-methyl-carbinol when incubated at 30°C. The higher temperatures of incubation interfered with the reversion of the M.R. reaction from acid to alkaline so characteristic of true *Aerobacter* organisms.

An incubation temperature of 30°C. for 24 to 48 hours and the Barritt  $\alpha$ -naphthol reagent are recommended for the V.P. test. An

incubation temperature of 30°C. for 5 days as originally recommended by Clark and Lubs (8) is desirable for the M.R. reaction.

The techniques recommended in *Standard Methods of Water Analysis* (8th ed., 1936) for the Voges-Proskauer reaction (24 to 48 hours at 37°C. with 10 per cent KOH as the test reagent) and for the methyl red test (3 to 4 days at 37°) are not conducive to the detection of the maximum number of Voges-Proskauer positive or methyl red negative strains and tend to obscure the correlation of these reactions.

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## **Adaptability of Various Pipe Line Materials In Water Main Construction**

*By L. R. Howson*

**I**N PRESENTING this discussion the author is fully aware of the controversial nature of the subject, however impartially presented. He is not so optimistic as to anticipate that this analysis and presentation will be wholly acceptable to any of the manufacturers of the various materials discussed. But it is hoped that consideration of some of the fundamental requirements governing the selection of pipe line materials, and the ability of the various materials to meet satisfactorily those requirements, will be helpful and provocative of further enlightened discussion on the principles involved.

The writer has no preference for any particular pipe line material as such, but possibly having arrived at that age associated with discretion, which is sometimes defined as that admirable quality which one acquires after he is too old to need it, may be charged by some with ultra conservatism. It is believed that each of these materials has its field of application.

In our discussion, let us first of all become thoroughly oriented. Let us not compare the efficiently coated, well protected, present day steel pipe with the bare steel pipe or the kalamein pipe known generally as steel pipe in the water works field a few decades back. Neither let us base our conclusions as to cast-iron pipe and its deterioration in carrying capacity upon studies made of cast-iron mains laid before the improvement in interior coatings of that material or with coatings selected without reference to the character of the water. Let us rather base our discussion upon the most modern development and the best utilization of the available materials.

A paper presented at the Indiana Section meeting at Indianapolis, April 26, 1939, by L. R. Howson, Alvord, Burdick & Howson, Engineers, Chicago.

At the present time the principal distribution system pipe line materials are: cast iron with interior lining of cement, standard coal tar or bituminous enamel and exterior coating, usually of coal tar; steel pipe with spun bituminous interior linings and the exterior protected by bituminous enamel alone or reinforced with wrapping; and transite pipe, a mixture of cement and asbestos fiber. These are the materials now almost exclusively used in sizes up to 24 inches.

Above 30 in. in diameter the use of steel and reinforced concrete has become quite general due largely to their superior behavior in case of breakage although some cities still use cast iron in the larger sizes.

This discussion relates particularly to the distribution system sizes up to and including 24 in.

#### Set of General Requirements Listed

Usually that method of meeting a particular set of requirements is best which accomplishes the desired result with the lowest annual cost. Selection of pipe materials on this basis involves consideration of:

- (a) Cost of installation.
- (b) Probable years of useful life considering effect of water on interior corrosion and soil on deterioration of exterior pipe surface.
- (c) Ability of available interior coatings to maintain initial water carrying capacity.
- (d) Record of past service of various materials adjusted to the improved coatings now available.
- (e) Factor of safety in pipe design to meet unforeseen and unpredictable loadings and stresses.

In water works service it is of course recognized that safety is the first consideration.

#### Installation Cost Analysed

Estimates of the relative costs of installation of the various pipe line materials have been made using quotations secured from manufacturers on sizes varying from 2 to 24 in., the sizes ordinarily used in distribution system service.

The quotations received cover materials differing in strength and other characteristics and are not believed to be comparable but are the figures secured in response to inquiry from various manufac-

turers for a quotation on pipe materials designed for 150 lb. operating pressure. They are therefore believed to be indicative of what would be supplied in response to inquiries from a prospective water works purchaser and are analysed herein on that basis.

To these quotations the cost of couplings and joint materials, excavation and backfill, hauling and miscellaneous expenses were added to arrive at comparable installed costs.

The cost of installation was figured for each material using a 50 cent per hour rate for common labor with corresponding skilled labor rates. Trenches were assumed to be excavated in clay with a minimum width of 12 in. greater than the internal diameter of pipe and with a cover of 5 ft. over the pipe in all cases. Costs of installation are comparable and are believed fairly representative of average

TABLE 1  
*Actual and Nominal Diameters*

	INCHES						
	2	4	6	12	16	20	24
Cast Iron.....	2.0	4.12	6.16	12.02	16.6	20.7	24.8
Standard Steel.....	2.067	4.026	6.065	12.09	15.34	19.312	23.25
Thin Steel.....	2.067	4.218	6.281	12.375	15.625	19.625	23.625
Transite.....	2.0	4.0	6.0	12.0	16.0	20.0	24.0

conditions throughout the central west where 50-cent common labor prevails in the smaller sized cities.

With respect to steel, two quotations were secured, one based upon standard weight steel pipe for all sizes up to and including 12 in. with a corresponding thickness reaching  $\frac{3}{8}$  in. shell thickness at 24 in. diameter, and the other based upon the thin shell section now offered competitively by a number of the steel manufacturers.

Cast iron is figured upon Class 150 Federal Specifications with lead substitute joints.

Transite pipe figures were on Johns-Manville, Class 150. Figure 1 shows the cost f.o.b. Chicago of the various materials. The points plotted on this curve are for the true internal diameters rather than the nominal sizes. These are as shown in table 1.

A similar comparison for the materials installed in trench is shown by the figures in table 2.

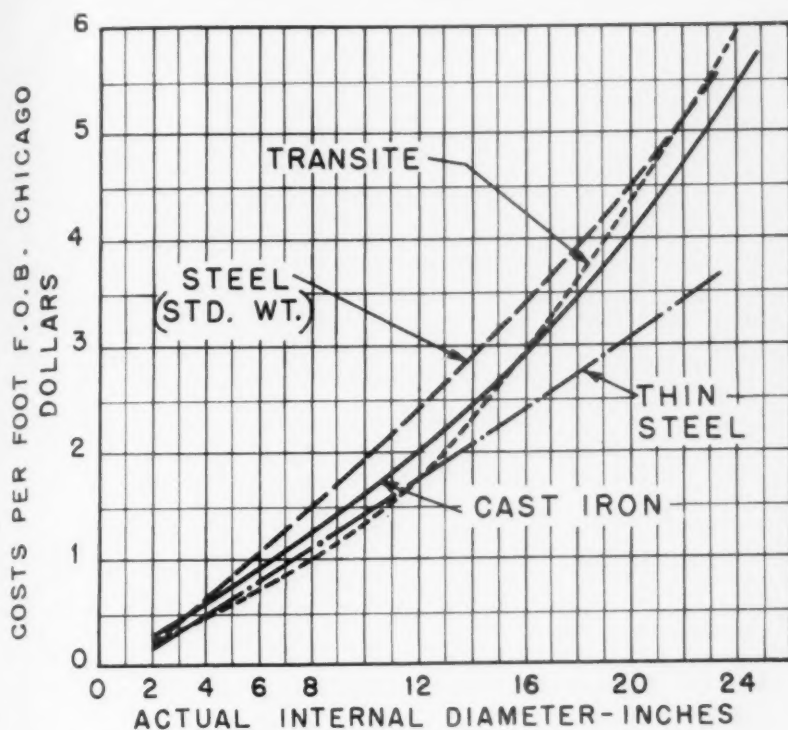


FIG. 1. Comparison of Cost of Cast-Iron, Steel, and Transite Pipe, f.o.b. Chicago

NOTE: Joint materials are included in each kind of pipe, and coating is also included with steel pipe.

#### TABULATION

*Cost of Pipe f.o.b. Chicago (Incl. Joint Materials)*

MATERIALS	DIAMETER IN INCHES						
	2	4	6	12	16	20	24
Cast Iron							
Class 150.....	\$.25	\$.57	\$.83	\$2.02	\$3.09	\$4.31	\$5.74
Steel Pipe							
Standard Uncoated.....	.17	.45	.76	1.90	2.58	3.46	4.63
Standard Coated.....	.30	.67	1.06	2.42	3.24	4.26	5.58
Thin Coated.....	.30	.55	.86	1.79	2.28	2.93	3.64
Transite							
Class 150.....	.235	.45	.70	1.72	2.99	4.28	5.89

Note that thin steel coated is cheaper than standard uncoated steel pipe for 12-inch and larger pipe.

### Annual Costs Compared

In making an annual cost comparison of these three pipe line materials it is necessary to consider, in addition to the interest on the investment, items such as life expectancy, carrying capacity and leakage which are directly reflected in the annual cost. Other considerations such as the background of experience in water works use are an aid in interpreting and weighing the figures of annual cost.

In computing the annual cost, interest is taken at 4 per cent and the depreciation requirements assumed to be met by the 4 per cent sinking fund method. A second computation was made with the depreciation allowance on a straight line basis but the relative posi-

TABLE 2  
*Estimated Cost of Pipe Laid in Trench*

MATERIALS	DIAMETER IN INCHES						
	2	4	6	12	16	20	24
Cast Iron							
Class 150.....	\$1.16	\$1.59	\$1.96	\$3.64	\$5.02	\$6.66	\$8.44
Steel Pipe							
Standard Uncoated.....	1.07	1.45	1.86	3.49	4.42	5.71	7.23
Standard Coated.....	1.20	1.67	2.15	4.01	5.08	6.51	8.18
Thin Coated.....	1.20	1.54	1.94	3.37	4.11	5.15	6.19
Transite							
Class 150.....	1.12	1.42	1.75	3.23	4.76	6.47	8.42

tions of the three materials were the same as when the 4 per cent sinking method was used.

It is of course universally recognized that the life expectancy of a material is affected by a variety of factors so that in making a comparison of this kind it is necessary to assume some particular set of conditions. With ordinary clay soils and the relatively hard, non-corrosive waters such as largely prevail in the central west it is believed that the lives adopted in this comparison are at least relatively in line.

With cast-iron pipe in the absence of unusually adverse soil conditions it is customary practice for engineers to give a life of 100 years, this being largely a measure of obsolescence rather than physical deterioration.

The life of plain uncoated steel pipe of standard thickness is taken

at 35 years. This is based upon the writer's observations of distribution system use of steel pipe in water systems of the central west supplemented by detailed study of over 4,000 inspections and pit measurements on some 7,000 miles of uncoated steel gas pipe lines in Ohio, Kentucky and West Virginia. Included in the observations were a limited number of coated pipe, some with tar coating only and others having a combined tar and fabric wrapping. It also included some observations of experience with Matheson and Converse joint steel pipe which has been in water works service approximately 30 years. As a result of these observations it is believed that 35 years for the standard weight steel pipe uncoated, 35 to 50 years for the thin section steel coated, and 75 years for the standard weight steel pipe with spun bituminous interior coating and exterior protected by bituminous coating and wrapping are in line with the allowances for the other materials.

Transite pipe has a shorter background of experience. It is reasonable to assume that its life would be somewhere comparable to that of reinforced concrete which most authorities give from 50 to 75 years life. In this comparison the author has given transite pipe 75 years of life expectancy which is believed to be liberal.

#### **Coefficient of Carrying Capacity Considered**

There is probably no more controversial item with respect to a comparison of distribution pipe line materials than that of carrying capacity. Transite, spun bituminous lined steel and cement lined cast iron all have smooth interior surfaces and about the same "C", coefficient of carrying capacity. Standard tar coated cast iron has a "C" about 10 per cent lower. The divergence in views, however, is primarily with respect to maintenance of capacity over long periods of service rather than with the carrying capacity of new pipe. Unfortunately there is a dearth of data with regard to the maintenance of carrying capacity of two of the materials, namely, transite and steel, with its new spun types of lining. There is a great deal of data with respect to the deterioration in carrying capacity of cast-iron pipe as so well developed by the Pipe Line Friction Coefficients Committee of the New England Water Works Association, and papers which have appeared in the Journal of the American Water Works Association within recent years.

With the accumulation of data it became apparent that deterioration in cast-iron pipe line carrying capacity is really a serious matter

and, as would be expected, this has resulted in efforts by the manufacturers to improve the quality of their linings. The principal improvement has been in the introduction and perfection of cement lining for use in waters that are particularly corrosive, such as those found in New England and the south Atlantic states and by the occasional use of a spun bituminous lining thicker than that normally applied by dipping. In general it seems to be the feeling among the manufacturers of cast-iron pipe that cement lining will solve the problem in the corrosive water areas and that improvements in the standard enamel lining will serve elsewhere. Certainly the deterioration of pipe line carrying capacity must be prevented insofar as possible.

It would seem probable that transite pipe would have somewhat the same characteristics as concrete pipe in respect to maintenance of carrying capacity. It would probably slime slightly but maintain a high carrying capacity for long periods. With steel pipe spun bituminous coatings are relatively new; only time can tell whether they will indefinitely maintain the carrying capacity of the pipe. The surface is very smooth and the indications are that they will be effective in maintaining carrying capacity for long periods.

In view of the dearth of data this comparison is based upon the assumption that with the improved coatings of cast iron and steel all three materials will have parallel experiences with respect to the maintenance of carrying capacity.

### **No Adjustment Made for Leakage**

There is of course a great deal of data with respect to the leakage on cast-iron pipe lines. The development of the A.W.W.A. standard specifications for laying cast-iron pipe presented last year under the committee of which W. C. Mabey was chairman, set as the permissible leakage allowance for cast-iron mains an amount not exceeding 100 gallons per day per inch mile. Transite and steel with their rubber type joints should equal this figure but there are insufficient data with respect to them. In view of the lack of information on the other two materials there has been no adjustment for leakage in this comparison.

Cast iron of all water works distribution system materials has the longest experience record, there being considerable amounts of cast-iron pipe, some of which is still in service, laid as far back as 100 years ago. Cast iron is a long life material. The deterioration in cast-iron

pipe lines is usually in their carrying capacity rather than in loss of strength of the material. In this study it is assumed that the proper selection of now available coating materials will prevent the deterioration in carrying capacity at least to anything like the extent it has been experienced in the past.

Cast iron continues to be the principal distribution pipe line material in the United States. During the past several years new cast-iron water main construction has averaged in excess of 5,000 miles per year.

Wrought iron and steel pipe have also a long background, although the type of steel presently used has a much shorter experience record. There was a considerable amount of relatively thin section steel pipe used in the northwest some 30 to 40 years ago in competition with cast iron and its high freight rate to that area. That pipe, however, is not to be compared with the present day steel pipe, primarily on account of the recent development in protective coatings. Steel as a metal corrodes much more rapidly than cast iron. Its life is dependent either upon the thickness of the shell or upon the protective linings applied to prevent corrosion or a combination of the two. The experience record since the better coatings have been available goes back only some 10 years.

Transite pipe has an experience record in this country of only 16 years and so far as any material quantities are concerned only half that period. The use of transite pipe has, however, been increasing in recent years, particularly during the period of P.W.A. Its use has quite largely been confined to smaller cities and the purchases made on a first cost, price competitive basis.

The manufacturer has furnished us figures showing the total length of transite tubing manufactured for all purposes, water supply, industrial, vent pipes, etc. from which it would appear that for the past two or three years something like 600 miles per year of transite water mains have been installed.

Table 3 shows the comparative annual cost of the various materials for all sizes of pipe from 2 to 24 in. inclusive. The data are shown diagrammatically on figs. 2 and 3.

This table and figures show for illustration that, with the 12-inch size, transite is the cheapest in annual cost for all materials if given a life of 75 years, but that if transite pipe is given but 50 years life cast iron is the lowest in annual cost for this size. Standard coated steel pipe with a thickness of 0.33 in. given a 75 year estimated life

has an annual cost less than for the spun lined thin steel with a thickness of .1875 in. given a 35 year life. It is just about as cheap on an annual cost basis to install heavier steel as to use the thin section with spun coating. The added thickness becomes its own corrosion protection and also furnishes a greater factor of safety all during its life than is available with the thin section.

In the 24-inch size cast iron with 100 years life, standard coated steel  $\frac{3}{8}$  in. thick given 75 years life and thin coated steel  $\frac{3}{16}$  in. thick given 35 years life, all are somewhat lower in annual cost than transite pipe given 75 years life.

TABLE 3

*Comparative Annual Costs per 100 ft. of Main*

Interest at 4 per cent

Depreciation by 4 per cent sinking fund method

Life: Cast-iron—100 years

Plain steel standard weight—35 years

Coated steel standard weight—75 years

Coated steel thin weight—35 years

Transite—75 years

	DIAMETER IN INCHES						
	2	4	6	12	16	20	24
Cast Iron.....	\$4.72	\$6.48	\$7.99	\$14.86	\$20.47	\$27.20	\$34.45
Uncoated Steel standard weight.....	5.78	7.81	9.98	18.79	23.81	30.74	38.94
Coated Steel standard weight.....	5.08	7.05	9.09	16.93	21.45	27.47	34.51
Coated Steel thin weight.....	6.45	8.27	10.39	18.05	22.00	27.59	33.14
Transite							
75 years.....	4.72	5.98	7.40	13.61	20.08	27.30	35.54
50 years.....	5.22	6.61	8.18	15.04	22.20	30.18	39.28

In making these comparisons no charge is made for the cutting and replacing of paving. Obviously the shorter lived material will have a materially added cost on this account and to that extent the exclusion of any consideration of paving costs is in favor of the short lived material. This accordingly is a greater advantage to the thick steel coated pipe as compared to the thin steel coated pipe.

#### Characteristics of the Pipe Line Materials

Cast-iron pipe beginning approximately 100 years ago has been the principal construction material in water distribution service in

this country. It was originally laid in shorter lengths, usually 9 ft., cast on its side with the irregularities in thickness resulting from that practice, and was uncoated. As time passed, vertical moulds were used in order to secure uniform sections and various types of protective coatings were used. Within the past 15 years, more or less,

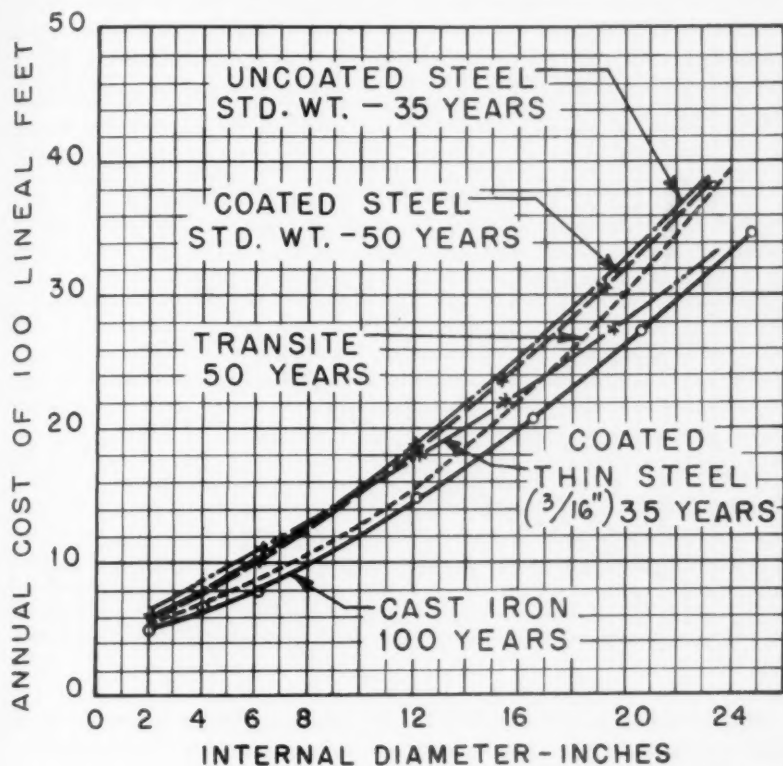


FIG. 2. Comparison of Annual Costs of Cast-Iron, Steel and Transite Pipe Lines, based on the following life assumptions: cast-iron, 100 yr.; coated steel, 50 yr.; uncoated steel, 35 yr.; transite, 50 yr.; and thin steel, coated, 35 yr.

NOTE: Annual costs consist of interest at 4 per cent plus depreciation figured on basis of 4 per cent sinking fund.

centrifugal and high tensile cast-iron pipe have been perfected and other methods developed for coating which are more resistant to tuberculation. Beginning with the cement lined pipe installed by Charleston, S. C., under the direction of James E. Gibson, a past president of the A. W. W. A., the use of this method of protecting the interior

of cast iron pipe has increased. The  $\frac{1}{8}$ -inch cement linings add about 10 per cent to the delivered cost of tar coated pipe. This type of coating is most largely used in the soft water areas east of the Appalachians and in the southeastern states.

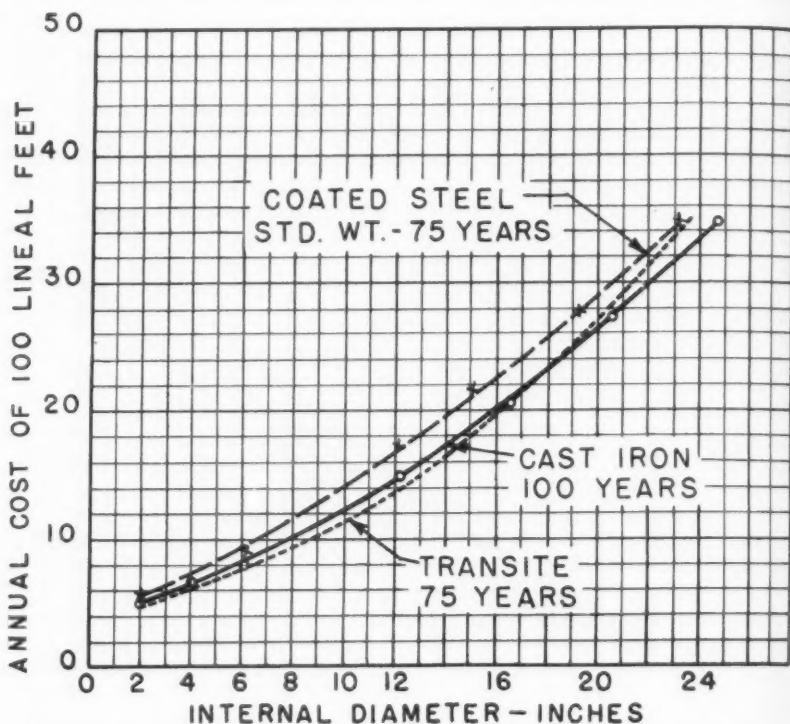


FIG. 3. Comparison of Annual Costs of Cast-Iron, Steel and Transite Pipe Lines, based on the following life assumptions: cast-iron, 100 yr.; coated steel, 75 yr.; and transite, 75 yr.

NOTE: Annual costs consist of interest at 4 per cent plus depreciation figured on basis of 4 per cent sinking fund.

A thin cement lining is now available without extra cost over tar. Spun bituminous linings like those used in steel pipe are also available at an increased cost of about 15 per cent of the pipe cost.

Cast iron is characterized by high resistance to corrosion, long life, tuberculation with many waters unless well protected by coating and with a sharp sudden fracture in failure. Its tensile strength is 25,000 lb. per sq.in.

Steel as a pipe line material has an elasticity not possessed by the other two materials and high tensile strength (50,000 lb. per sq.in.) which results in the possibility of using comparatively thin wall sections. It is subject to corrosion within and without and its adaptability to water works use has accordingly been quite dependent upon the development of protective coating. The bituminous enamel spun lining gives promise of having supplied the solution to the protection of the interior of steel pipe. There is a background of less than 10 years with this method of application. The behavior of this type of lining is, however, indicated from the experience with bituminous enamel linings applied by hand brushed method. With this type of application there is a background of approximately 20 years which shows a high resistance to deterioration and a corresponding well maintained coefficient of carrying capacity. In fractures, steel pipe due to its elasticity does not break suddenly like the more brittle materials. It is largely on this account that, in the large diameters, steel and reinforced concrete (the strength of which also depends upon steel) have been increasingly used.

Transite pipe made of cement and asbestos fiber is characterized in appearance by a smooth semi-polished cement color. It has a tensile strength of about 4,000 lb. per sq.in. with an elastic limit 90 per cent of this ultimate strength. In fracture, transite pipe more closely resembles cast iron than steel.

Transite pipe was first introduced in Italy and considerable quantities have been used throughout Europe. It was first introduced into the United States about 1926. The joints in transite pipe are made with Simplex couplings which consist of a transite sleeve and two rubber rings. The joint has considerable flexibility.

#### Factors of Safety Compared

A comparison of various pipe line materials should fairly be based upon comparable factors of safety. In order to ascertain the facts relative to the quotations on the three types of pipe here under consideration an analysis has been made of the factors of safety using for all types of materials the modified Fairchild formula for ascertaining the thickness of pipe. This formula consists of three parts:

- (1) A determination of that part of the thickness required for the actual internal pressure.
- (2) The additional thickness required to take care of water hammer.

- (3) The thickness over and above the first two required for trench loading, corrosion, tolerance in manufacturing thickness and other indeterminate requirements.

Cast iron pipe design has included an allowance for all three factors. With respect to steel and transite pipe, however, that is not the case.

In order to show this basic difference more clearly and its effect

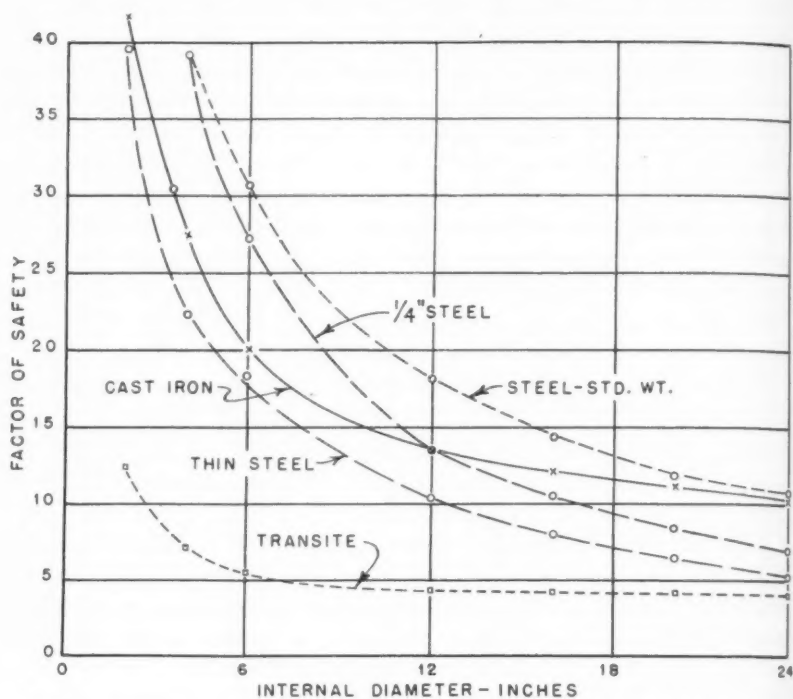


FIG. 4. Comparison of Factors of Safety of Steel, Cast-Iron and Transite Pipe, based on 150 lb. working pressure and using Fairchild's formula for bursting strength only (part 1).

ULTIMATE STRENGTH: Steel, 50,000 lb. per sq.in.; cast iron, 25,000 lb. per sq.in.; and transite, 4,000 lb. per sq.in.

upon the factor of safety of the various types of materials the Fairchild formula has been applied to an analysis of the strength of the materials quoted. Taking first that part of the formula relating only to the stresses resulting from internal pressure it is obvious they will be identical whether the pipe material be cast iron, transite, or steel. Figure 4 shows the facts relative to the three materials. For

the 12-inch size cast iron, Class 150 has a factor of safety against internal working pressure only of 13.7 as compared to 18.1 for standard weight steel, 10.2 for thin steel and 4.35 for transite. These figures decrease with the larger sizes until the heavy steel and cast iron are about 10.5 for 24-inch pipe and the thin steel at 5.3 approaches transite at 4.05 for 24-inch pipe. All through the range of sizes cast iron and standard weight steel have a factor of safety against internal working pressure alone of from 2 to 3 times that of transite and materially greater than that for the thin steel.

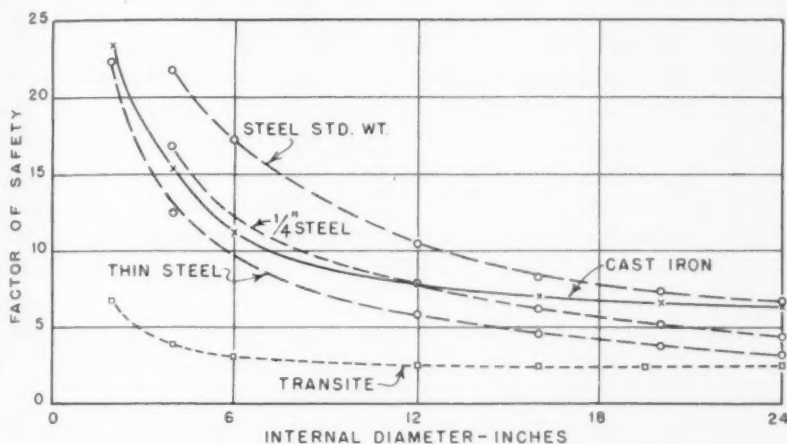


FIG. 5. Comparison of Factors of Safety of Steel, Cast-Iron, and Transite Pipe, based on 150 lb. working pressure and water hammer allowance using Fairchild's formula (parts 1 and 2).

WATER HAMMER ALLOWANCE: 10 in. and under, 120 lb. per sq.in.; 12 to 18 in., incl., 110 lb. per sq.in.; 20 in., 100 lb. per sq.in.; and 24 in., 95 lb. per sq.in.

ULTIMATE STRENGTH: Steel, 50,000 lb. per sq.in.; cast iron, 25,000 lb. per sq.in.; and transite, 4,000 lb. per sq.in.

This may be visualized in another way by the fact that the thickness of cast iron with its tensile strength of 25,000 lb. per sq.in. is practically  $\frac{1}{2}$  as much as transite with its tensile strength of but 4,000 lb. per sq.in. In other words transite has but  $\frac{1}{6}$  the tensile strength and being but twice as thick must necessarily have a factor of safety but  $\frac{1}{3}$  as great as cast-iron pipe.

Now if in addition to internal static pressure of 150 lb. per sq.in. we include a water hammer allowance varying from 120 lb. per sq.in. for pipe 10 in. and smaller to 95 lb. for 24-inch pipe, similar facts are

disclosed. It should be equally obvious that water hammer will occur in a pipe line irrespective of the pipe line material and that accordingly this factor must be given equal consideration in all types. Figure 5 shows the comparison of the factors of safety for the various materials when the stresses due to water hammer are combined with the stresses resulting from the internal pressure.

Again taking for illustration the 12-inch size, standard weight steel has a factor of safety of 10.4; cast iron, 7.9; thin steel, 5.9; and transite, 2.5. For the 24-inch size the standard weight steel and cast iron have approximately the same factor of safety, about 6.5, the thin steel is 3.2 and the transite, 2.5. Here again for all sizes the transite pipe has a factor of safety of but about  $\frac{1}{3}$  that of cast iron and standard weight steel. For the larger sizes the thin steel approached the transite so far as factor of safety is concerned.

No attempt has been made to compute the extra thickness required for trench loading, handling, tolerance of thickness, etc., for other than cast-iron pipe. Certainly some allowance must be made and as none has been made in the standard design for either steel or transite, the effect is to reduce still further the factors of safety in those materials.

So far as factor of safety is concerned it is believed that cast iron and standard weight steel are comparable in sizes 12 in. and above and the thin steel materials are reasonably comparable up to 12 in.

Transite provides factors of safety of but from  $\frac{1}{3}$  to  $\frac{1}{4}$  those of cast iron or steel allowing only for stresses resulting from internal pressure plus water hammer in both cases.

#### Strength Purchased per Dollar of Investment

In buying pipe line materials the purchaser acquires strength and carrying capacity. As previously stated the tensile strength of the three materials varies from 50,000 lb. per sq.in. for steel to 25,000 lb. per sq.in. for cast iron and 4,000 lb. per sq.in. for transite. It is reasonable therefore that the stronger materials should have thinner wall thickness.

In order to visualize the facts with respect to the three materials, a computation has been made to determine with the pipe wall thicknesses offered in the quotations the amount of ultimate strength purchased per dollar of investment. The results of this computation and analysis are shown diagrammatically on fig. 6.

Taking for illustration the 12-inch size, each dollar expended for

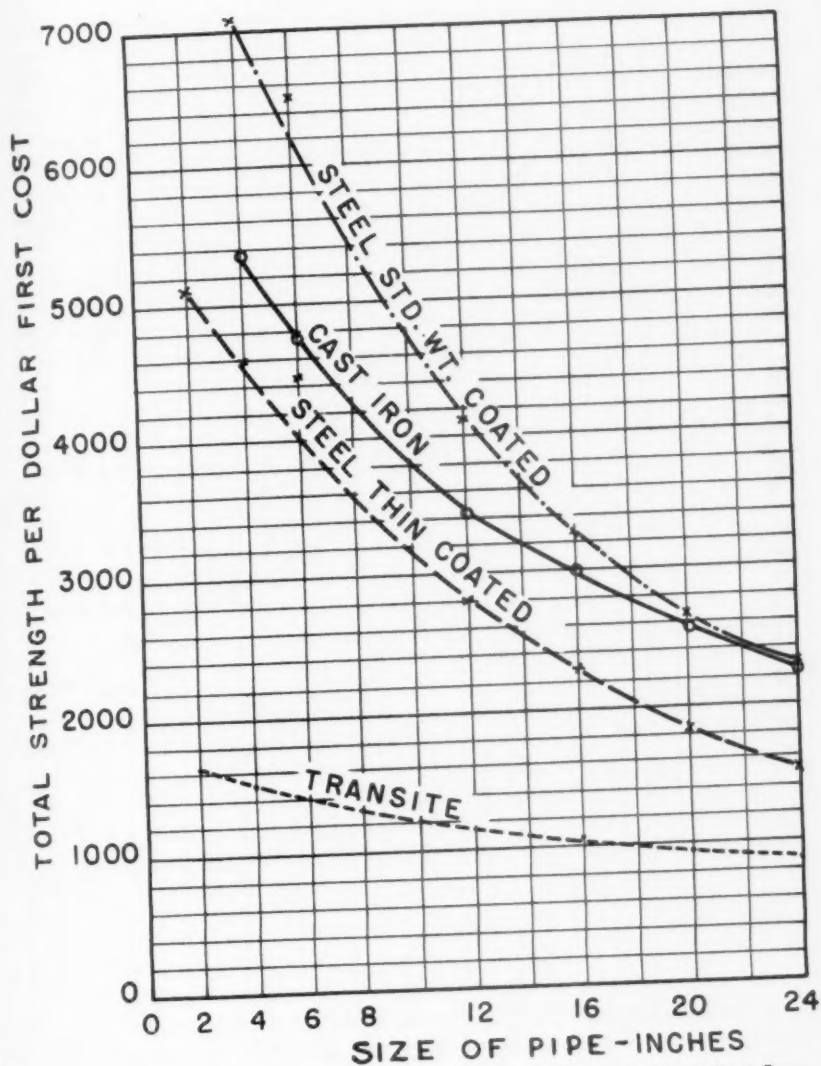


FIG. 6. Comparison of Total Strength per Dollar First Cost of Cast-Iron, Steel and Transite Water Mains.

NOTE: Total strength = thickness  $\times$  ult. tensile strength. Cost includes trenching and laying but no paving.

cast iron buys 3,430 lb. tensile strength; transite, 1,215 lb.; standard steel, 4,110 lb.; and thin steel, 2,790 lb. Similarly for the 24-inch size each dollar expended for cast iron buys 2,250 lb. tensile strength;

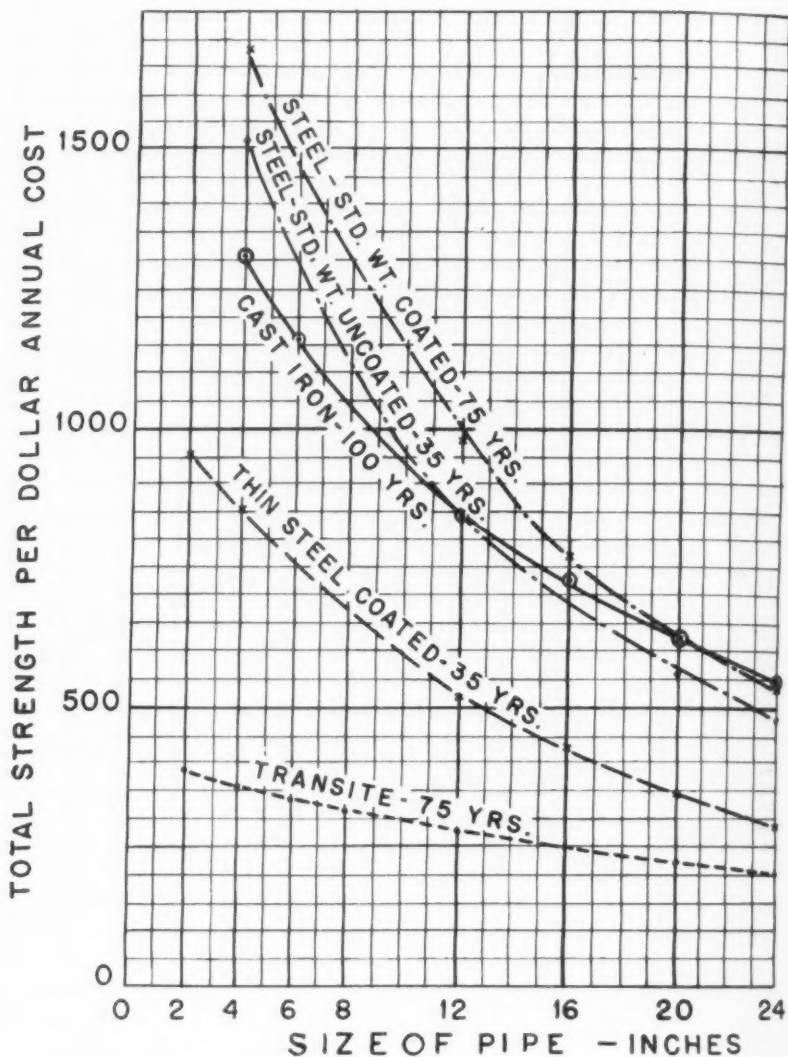


FIG. 7. Comparison of Total Strength per Dollar Annual Cost for Cast-Iron, Steel and Transite Water Mains.

NOTE: Annual cost based on 4 per cent sinking fund. Costs include trenching and laying but no paving.

transite, 865 lb.; standard weight steel, 2,290 lb.; and thin steel, 1,519 lb.

### Strength Purchased per Dollar Annual Cost

Annual cost which takes into consideration the prospective life of the material is probably a better indication than that of material cost alone. A second study has therefore been made to determine the pounds of strength purchased for each one dollar annual cost per 100 ft. of main. The results are shown diagrammatically on fig. 7. The figures are comparative each to the other, cast iron being figured on a 100-year life; transite on 75; standard steel coated on 75; thin steel coated on 35; and standard weight steel without coating on a 35-year life. Taking for illustration the 12-inch size each one dollar in annual cost for 100 ft. of main buys 841 lb. when expended for cast iron; 288 lb. for transite; 973 lb. with standard steel coated; 521 lb. with thin steel coated; and 890 lb. with standard weight steel, no coating.

### Summary

Again taking the 24 in., each one dollar per 100 ft. buys 550 lb. tensile strength in cast iron; 205 lb. in transite, 544 lb. in standard steel coated, 284 lb. in thin steel coated; and 481 lb. in standard steel with no coating.

These figures are illustrative in dollars and cents of the comparative factors of safety purchased in the different materials quoted upon.

There has been an increased appreciation of the desirability of maintaining pipe line carrying capacity. Desirable as this may be it should not be permitted to detract from the even greater importance of providing adequate factors of safety in the construction of pipe lines and the selection of pipe line materials. It is believed that both safety and maintenance of carrying capacity are prime requisites of a satisfactory pipe line material. Each of the materials herein considered has a place in the water works field. It is the author's opinion that materials ought not to be used for pressure to which they are not adapted with adequate factors of safety, and also that materials ought not to be offered under water conditions and with coatings poorly adapted to the character of water to be carried. With the proper selection of materials for the pressure conditions under which they will be required to operate and the proper selection of the available linings and coatings there is adequate assurance that both requirements can be met. Experience of the past is the best guide to the future and that experience properly analysed will from time to time indicate improvements in the manufacture, and the limits of desirable application and installation of all of the available pipe line materials.



## Treatment by Coagulation and Sedimentation Without Filtration

By George H. Bragg, H. B. Foster, Jr., and W. E. Wentworth

**George H. Bragg.** Among the responsibilities of the water works man, there is, on the one hand, the obligation to the customers to furnish them safe water at a minimum cost and, on the other hand, the obligation to the Company to so regulate the cost of giving the service, that the rates may be held to a minimum, thereby making it possible for the poorest customer to purchase and pay for all the water he needs for all of his domestic uses without straining the family budget.

In the pursuance of these principles, in the Mother Lode mining districts in central California, known as the Mark Twain and Bret Harte country, the domestic water supplied to the several towns is being clarified by sedimentation and in some instances by coagulation, then sterilized by chlorination without filtration.

When the pioneer gold miners first started operations, they constructed ditches, flumes and siphons to convey the water from the natural streams to their mining claims for the purpose of separating the gold from the sand and rocks. Later when settlements took form, the ditches were tapped to supply the domestic needs. The water was piped to the cabins in the raw state. It was fairly clear in summer but throughout the rainy season the turbidity was high. Pollution, however, was negligible because the population was sparse. As time passed, the objectionable quality of the water was accepted with little or no criticism because the thought prevailed that the condition was inevitable. The people did not complain but joked about the mud in the water. The traveling salesmen never

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A symposium presented at the California Section meeting at Riverside, California, October 27, 1938, by George H. Bragg, Engineer of Maintenance, Pacific Gas and Electric Co., San Francisco; H. B. Foster, Jr., Junior Sanitary Engineer, Bureau of San. Eng., State Dept. Health, Sacramento, California; and W. E. Wentworth, Sanitary Engineer, Water Department, Vallejo, California.

failed to relate to their friends that it was necessary to use a feather duster after taking a bath in the country hotels.

There came a time, however, when the density of population having greatly increased, it was necessary to chlorinate the water and a little later to clarify it.

The facilities designed for the treatment of these gravity supplies are conventional, consisting of a diversion structure, sedimentation basin, clear water reservoir and a building to house the treating apparatus, all located near the ditch and as close as possible to the town. A typical plan is that of the Sonora water supply shown in fig. 1. The open canals traversing many miles of wooded hillsides continuously intercept enormous quantities of wind-blown leaves, twigs, etc. Some of it floats and some sinks but all is carried with the water until it lodges on coarse rack-bars set in the ditch upstream from the diversion of the domestic supply. By making these racks liberal in area, the accumulation in twenty-four hours does not stop the flow of water and so it is sufficient to have them cleaned once a day by the ditch tender as he patrols his beat.

The finer debris, not caught by the racks, lodges on a perforated metal plate set in the domestic supply conduit. This likewise is usually cleaned at regular intervals by the ditch tender, but in the instance of Sonora the cleaning is accomplished continuously and automatically by means of a revolving perforated metal cylinder which makes use of the power of the main head of flowing water in the ditch to do the work. (See figs. 2 and 3.)

The domestic supply passes through the perforations to the inside of the cylinder, thence out at the open end to the sedimentation basin. The fine debris which clings to the outside of the cylinder is washed off and carried away by the flowing water in the ditch.

The heavy sand, eroded from the hillsides into the ditches by the rains, settles to the bottom and slowly moves along until it is trapped in a sandbox, whence it may be discharged intermittently by opening a sluice gate. The raw domestic water is thus delivered, fairly free from floating debris and sand but, nevertheless, turbid. It is then discharged into the sedimentation basin. This is a concrete-lined reservoir holding several days' supply. It is well baffled to cause the water to move in a circuitous route from inlet to outlet.

A retention period of several days is adequate to clarify the water if the turbidity is not due to colloidal clay in suspension. Therefore, some supplies clarify by sedimentation only while others require the addition of alum to form a floc.

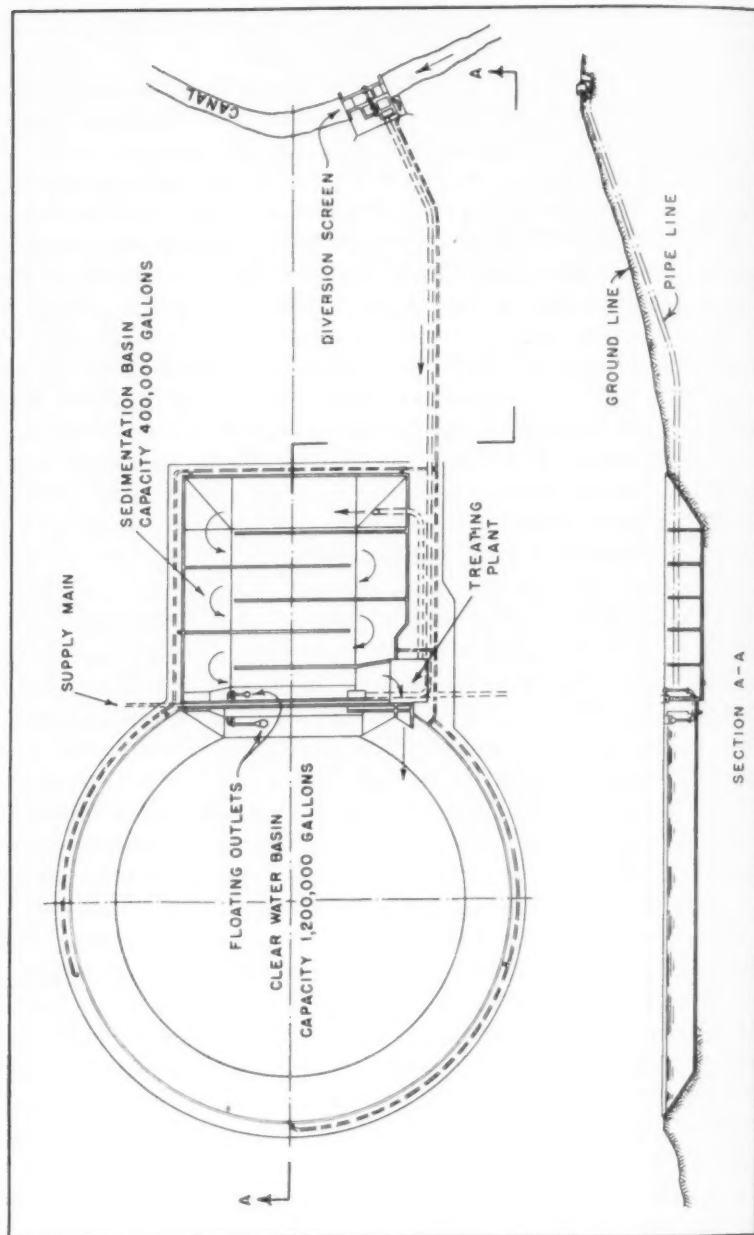


FIG. 1. Clarification Works and Reservoir at Sonora, California

The clearest water is, of course, at the surface of the most remote part from the inlet; hence the draught into the clear water reservoir is skimmed by means of a floating outlet. This is shown in figs. 4 and 5. This pipe is connected to a swivel elbow near the bottom of the basin while the open end is supported near the surface by a metal float of such buoyancy that as the water level rises and falls, the open end of the pipe is maintained a few feet below the surface. It is obvious that an important feature of the floating outlet, aside from drawing the clearest water at all times, is its capability to draw off automatically all the water in the basin if necessary to supply any abnormal demand, such as for fire, etc.

The clear water reservoir is also a concrete-lined excavation with the sides raised several feet above the surrounding ground line to

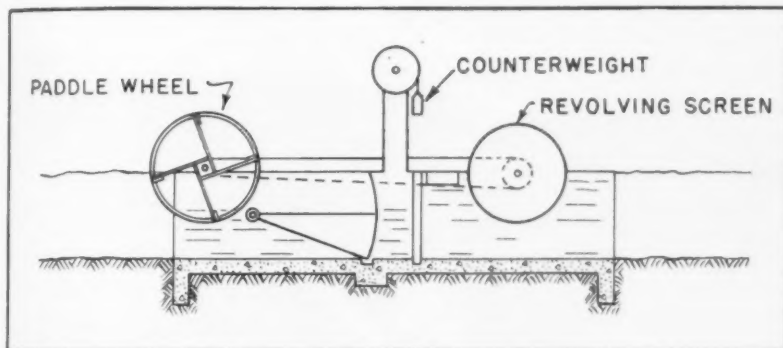


FIG. 2. Revolving Diversion Screen

keep out the inflow of surface water and also the creeping and crawling bugs, frogs, reptiles, etc. It, likewise, is equipped with a floating outlet through which the water passes to the force main.

The supply is chlorinated usually as it passes from the sedimentation basin to the clear water reservoir. Once each day the plant is visited by an employee who regulates the quantity of flow to be diverted from the ditch for the next twenty-four hours; then he readjusts the chlorination accordingly and services and adjusts the alum feeder.

At stated intervals he collects water samples for the determination of the residual chlorine in the clear water reservoir and also other samples for the determination of coliform reduction by laboratory methods prescribed by the State Board of Health. A continuous

and permanent record is being carefully kept on file for reference at any time.

Both reservoirs are emptied and cleaned once a year, the walls being thoroughly brushed and washed clean of the deposit on them. This is accomplished without service interruption or storage reduction by programming the work so that both reservoirs will not be emptied simultaneously. A system of pipes and valves is used to by-pass the water temporarily from one reservoir to the other.

The turbidity of the raw water may vary from a maximum of 500 parts per million during heavy rainstorms to a minimum of 25 p.p.m.

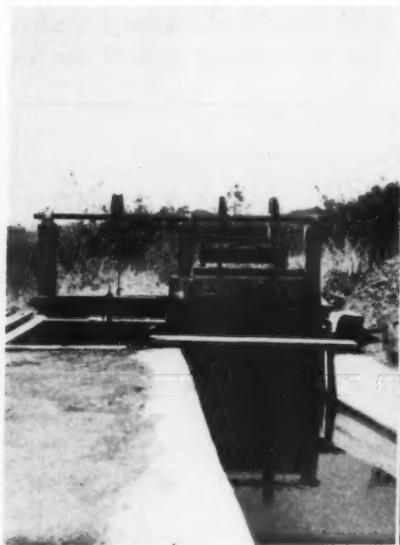


FIG. 3



FIG. 4

FIG. 3. Revolving Diversion Screen

FIG. 4. Floating Outlet in Sedimentation Basin

throughout the dry season each year. By sedimentation during all seasons, a further reduction to approximately 5 p.p.m. is continuously maintained.

The dosage of alum has been determined by laboratory tests as well as by experience, the optimum value being a rate of one grain per gallon which is independent of the turbidity of the raw water. The natural alkalinity of the supply is such that no artificial change is needed by the admixture of lime to obtain a good floc quickly. In the laboratory a reduction from 1,000 p.p.m. to 40 p.p.m. was

obtained in approximately one hour by a dosage of one grain per gallon.

In closing, may it be understood that the water clarified by coagulation and sedimentation by the facilities described herein is not equal in quality to a water that has had the additional refinement of

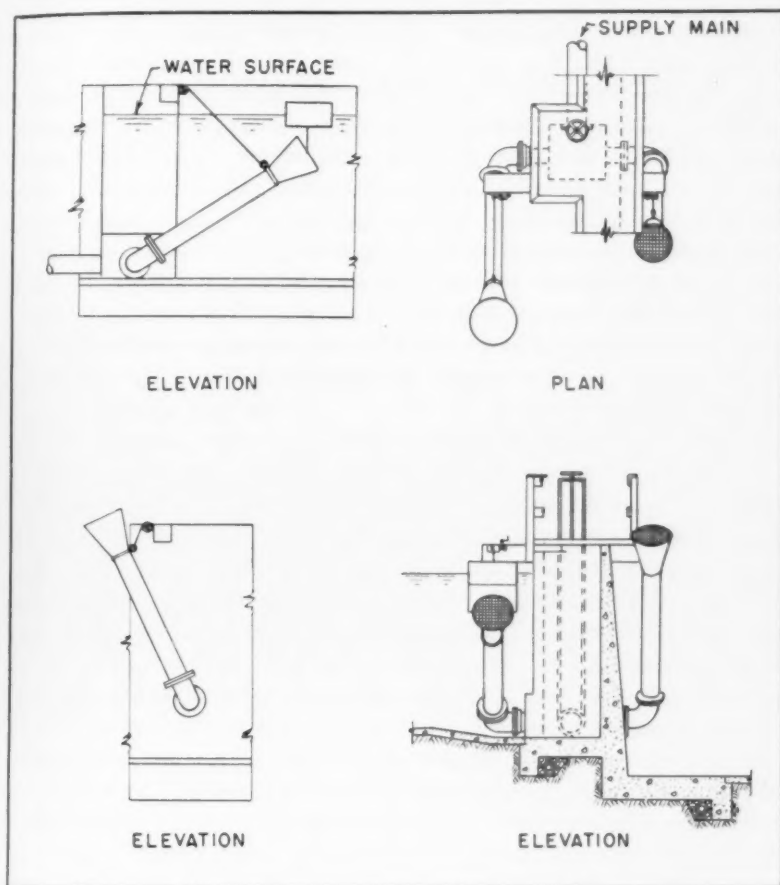


FIG. 5. Design for Floating Outlets at Sonora, California

filtration. Considering the comparatively slight improvement to be gained by filtration, it is doubtful if the majority of the customers would choose the best quality obtainable if it were made clear to them that the cost would necessarily bring about an upward revision of the existing rates.

**H. B. Foster, Jr.** Along with rising standards of living, more perfect water supplies have been demanded by the public. A water free from harmful bacteria was the first demand to be satisfied, and as a result most communities have now acquired a safe or reasonably safe supply. Later, greater emphasis was focused on the physical purity of the water. This trend is increasing and is a major problem of water works men. Many characteristics make for the physical perfection of a water. Perhaps the earliest improvement to be sought was clearness. Thus came plain settling in large storage reservoirs and later water filtration, first through slow sand filters and in the 90's, through rapid sand filters. Coagulants were usually used ahead of the rapid sand filters. These methods have been the chief measures for the purpose of water clarification.

Filtration, however, like everything worthwhile, costs money and in many cases this cost is more than a small community or the customers of a small water company can afford. There are many such cases in California and in several instances a fairly satisfactory answer has been found in simple coagulation followed by adequate sedimentation.

Simple water coagulation and settling is of course not new. Here in California, it was the outgrowth of persistent complaints against muddy water in the Mother Lode Country in the Sierra Mountains where water originally of pristine purity is carried long distances in the earthen ditches (inherited from the gold mining days), and picks up more or less turbidity. Mere coagulation is not intended to give a polished water. The result amounts to knocking down the higher turbidities.

The Pacific Gas and Electric Company, serving many foothill communities, was one of the first to use this method on its ditch supplies for the towns of Auburn and Sonora. The first installation was made in 1927 and the results have been so sufficient for the purpose that the treatment is still in use and has been adopted elsewhere. The cost of the undertaking was small and obviously a safe gamble, for gamble it seemed to be at the time. Redding, The Marin Municipal Water District, Roseville, Oroville, Lincoln and Vallejo also use coagulation without filtration.

Coagulation without filtration as an emergency measure was used by the city of San Francisco several years ago. Normally the waters are clear, but on one occasion the storage lakes were practically empty and the water became very turbid. The condition was

cleared by adding alum to the main transmission lines from the lakes and allowing the water to settle in the large distributing City reservoirs. The Water Purification Division of the City of San Francisco has recently carried on a careful study of coagulation of the Calaveras water because of excessive turbidity in the winter months. Experimental work is reported to have produced very satisfactory results.

### Three Types of Water Treated

In California, there are three types of turbid waters treated by coagulation alone. The most common happen to be the ditch supplies from the Sierra foothills. These are essentially soft snow waters, low in alkalinity, but defiled by fine-grained turbidity. A second type is water straight from the more or less turbid Sacramento River. The third is impounded water, more or less muddied by rapid winter filling, although this turbidity does not reach the high peaks of the other two types. Coagulation is used on lake water mainly to decrease the turbidity, but it also helps in carrying down algae in the summer months. Alkalinity, which is important in the chemical reaction that takes place in coagulation, is higher in both the river and lake waters than in the ditch waters.

The scheme of treatment is simple. First, the heavy turbidity, if any, is settled out in settlers that are provided with facilities for easy desludging. As the water leaves the settler or at some other more convenient place, alum is added, either in a dry form by mechanical feeding machines or in solution by simple orifice box controls. Some of the installations for solution feed would be classed as rather crude by those who are acquainted with up-to-date filtration plants, but when they are properly cared for they produce most acceptable results. At many places, especially the ditch supplies, the water treated is obtained at a uniform rate, so the problem of adding chemicals is greatly simplified. The coagulant, I believe, in all cases so far in this state is aluminum sulfate.

Mixing the water to form the floc takes place either in the existing ditch or the pipe line. The time of mix varies from a few minutes to one-half hour. At Roseville, a short, steep, rocky ditch is used. At Oroville, the ditch is large with a rather sluggish current, particularly at the lower end where the section widens and most of the settling is accomplished before the water enters the reservoir.

At most of the plants, flocculated turbidity is allowed to settle

out in smaller reservoirs operated as settling basins. These settling basins in many cases are the old storage reservoirs used prior to the time when coagulation was installed. At some places they are formed by mere earthen embankments. They generally hold several days supply. At Reno, Nevada, a very large reservoir failed to produce satisfactory results because winds stirred up the light floc and coagulation was therefore discontinued. The periods between cleanings vary widely. I think none are cleaned more often than every few months. Most are cleaned once a year. They are usually drained and the sludge is sluiced out by hose. At one place the reservoir is cleaned with a scraper.

The removal of turbidity in the cases with which I am familiar has generally been close to 90 per cent of that in the raw water. Since the removals adhere rather closely to a percentage figure, finished turbidities sometimes run higher than would be generally acceptable. As a rule, however, finished turbidities do not exceed 20 or 30 parts per million and the public is quite satisfied. Occasionally, remarkable results are obtained, e.g., turbidities are reduced from say 50 to only one or two parts per million, which gives a sparkling clear water.

#### Residual Turbidity Accumulates in System

It should be pointed out, however, that any residual turbidity entering the distribution system tends to cause accumulations when velocities are low and the deposits are flushed out at times of excessive flows—an illustration of some of the limitations on this method. Still another limitation is the ease with which fine alum precipitate escapes into the distribution system. In one case, the alum could be seen as a crust on the outside of cooling pipes, over which it passes.

Red water seems not to have been experienced though it is difficult to see why this trouble should not occur, considering that the alkalinity of the raw waters in so many cases runs only 15 to 40 p.p.m. It may be that the residual turbidity and perhaps the alum leaves enough of a coating on the pipes to protect them. Not all waters will respond to this coagulation treatment. Experiments by field laboratory tests indicate that even with effective mixing some water will not coagulate unless it is treated with additional chemicals such as soda ash or lime. No such waters are now being treated in California by coagulation without filtration.

**W. E. Wentworth.** As in some other places, the existing water treatment plant at Vallejo is the result of accretion of treatment facilities over a period of years, to keep pace with increasing consumption and higher standards of purity. Until 1932, the plant consisted principally of two flow meters, a chlorination unit, some aeration facilities and two distribution reservoirs. Public demand for a water of better quality resulted in augmentation of treatment facilities at that time.

The entire supply is derived from surface run-off, collected during the rainy season from two watersheds. The smaller produces water of the following characteristics: alkalinity, with respect to methyl orange, from 9 to 48 parts per million, average 24 p.p.m.; total hardness, as calcium carbonate, from 16 to 59 p.p.m., average 37 p.p.m.; chlorides, from 6 to 14 p.p.m., average 9 p.p.m.; pH, from 6.8 to 8.1, average 7.4; turbidity, from 0 to 600, average 9; iron and manganese, negligible. This is considered an exceptionally desirable water chemically.

The larger watershed produces a product of different characteristics, as follows: alkalinity, 96 to 166 p.p.m., average 133 p.p.m.; total hardness, 115 to 187 p.p.m., average 148 p.p.m.; chlorides, 8 to 22 p.p.m., average 15 p.p.m.; pH, 7.5 to 8.6, average 8.0; and turbidity, 0 to 600, average 18; iron and manganese in solution have reached maximum concentrations of 28.2 p.p.m. and 5.9 p.p.m., respectively. This water is considered less desirable, chemically, than the first. The foregoing figures cover the period from January, 1932 to October, 1938. The policy of mixing the two, in the proportion of approximately one part of the former to two of the latter, is dictated by the respective quantities available.

The present plant of three million gallons daily, design capacity, operates under gravity and provides aeration, pre-chlorination, coagulation, sedimentation and final sterilization with chloramine. Aeration is effected by twenty nozzles of rifled type set vertically on four headers. Aerators can be noted in background of fig. 6. The coagulant mixing and dosing plant, utilizing sulfate of alumina in 6 per cent solution, consists of a mixing box, solution tank and combined constant head and orifice box. The coagulant is of granular size to facilitate solution, which is effected manually. The solution is added to the water immediately after aeration. Coagulant required, set on the basis of results attained, averages less than one grain per gallon, with a maximum of one and one-quarter



FIG. 6. Water Treatment Plant at Vallejo. Note aerator in background

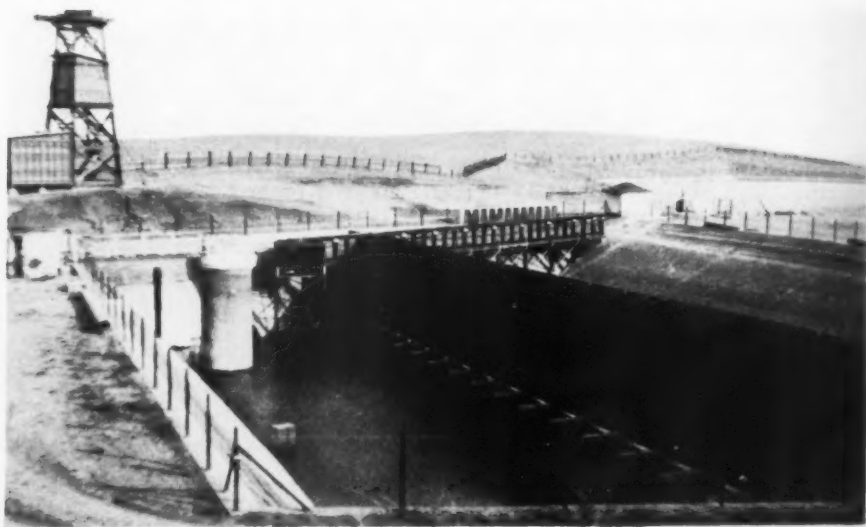


FIG. 7. Mixing Flume and Sedimentation Basin De-watered

grains per gallon. Immediately after the addition of the coagulant, chlorine is added, principally to facilitate clarification, the amount ranging from 0.7 to 2.0 p.p.m.

The water next passes through a 116-foot redwood mixing flume, fitted with over-and-under baffles at intervals of 3 feet 4 inches. The flume grade is  $1\frac{1}{2}$  per cent; cross-section is 6 by 4 feet; and alignment parallels one side of the sedimentation basin. The outer end, which is flared, turns seventy-three degrees for proper direction of flow, and discharges at reservoir level. The period of retention is about 10 minutes.

The character of the sedimentation basin is considered of primary importance in the success of the plant in operating without filters. This concrete-lined basin, the smaller of two, was built for a distribution reservoir, and was so used for many years. In plan it is an isosceles trapezoid, is 20 feet in depth and 4 million gallons in capacity. The top lengths of parallel sides are about 185 and 290 feet, respectively; non-parallel sides, about 166 feet. The bottom is of less size in the amount of the respective wall slopes, one to one in three cases, and two to one in the fourth. The area available to receive sediment, including the sloping walls, is 0.96 acres (see fig. 7).

#### From Distribution Reservoir to Sedimentation Basin

The change in use from distribution reservoir to sedimentation basin involved only the addition of suitable inlet, baffle wall and outlet. This wall, to induce proper circulation, is of wood, T section and constructed longitudinally in the basin. Capacity of the basin indicates an average period of retention of about one and six-tenths days; actually it is less; and is influenced by wind direction and velocity. The outlet, a concrete-lined, open channel, 3 by 4 feet in section, fitted with baffles for mixing chlorine and ammonia with the water, is located adjacent to the incoming conduit, thus compelling the water under treatment to make a complete traverse of the basin. The outlet is arranged to draw from the top two feet of water. The only treatment, subsequent to sedimentation, is sterilization with chlorine and ammonia, which are administered in this channel between basin and clear well.

The diameter of particles in millimeters, such that 75 per cent will be removed with continuous operation, computed from Hazen's formula, using 1.73 for the factor "f," is .007 millimeter. The figure is given merely to convey a comparative idea of the efficiency

of the basin. Cleaning, which is done by de-watering and sluicing with hoses through a bottom drain, is normally done three times a year. Longer periods between cleaning are undesirable because of fermentation of sludge in the basin. The uniform decrease in depth of sludge, varying from an observed maximum of seven feet near the inlet to a minimum of a few inches near the outlet is added evidence of satisfactory performance. Further verification of this fact is furnished by the uniformly increasing depth to which light penetrates the settling water, as evidenced by the plant growth on basin walls, ranging from a few inches at the inlet to sixteen feet near the outlet.

The clarity of the plant output has repeatedly been such that the depth of visibility of an 8½ inch diameter, white-enameled plate has been the entire depth of the clear well at the time, this having reached an observed maximum of twenty-three feet. Clear well temperatures have varied from 44 to 75 with an average of 62 degrees Fahrenheit. Other characteristics of the plant output given in five year averages are as follows: alkalinity (methyl orange), 81 p.p.m.; total hardness, 103 p.p.m.; chlorides, 15 p.p.m.; pH, 7.9; and turbidity, one. Iron and manganese are held below a combined total of 0.5 p.p.m. Bacteriological quality is well within the standards promulgated by the United States Public Health Service. The present plant can be augmented by minor additions to increase its capacity 65 per cent.

An appreciable fault with the existing plant lies in the difficulty encountered in maintaining the quality of the water in the clear well after treatment is completed. A growth of *Protococcus* recurs there with high temperatures; control with copper sulfate has proven impracticable but can be effected by chlorine residuals above 0.30 p.p.m. The trouble can be obviated by covering the clear well and, in any case, is independent of the scheme of prior treatment.

Undoubtedly the treatment described would be inadequate for many waters, but it is anticipated that the present method of purification here will continue to produce an output of satisfactory quality until conditions warrant the expenditure of a large sum for a completely modern plant commensurate with the highest standards.

The plant is operated by W. E. Wentworth, Sanitary Engineer, Vallejo Water Department, under the direction of T. D. Kilkenny, City Engineer and Frank Brew, Commissioner of Public Works.



## **Symposium on Unusual Water Treatment Methods and Equipment**

### **Hydraulic Wash Water Valve Control**

*By Fred R. Lauterbach*

The City of San Diego's Torrey Pines pump and filter plant receives water through a 5-mile pipe line under plant operating pressure of 41 to 56 pounds, depending upon the rate of flow. After passing through the filter plant, consisting of seven rapid sand pressure filter units with a capacity of  $\frac{1}{2}$  million gallons daily each, installed in 1921 (enlarged in 1926), the water is pumped against a pressure of about 175 pounds to Torrey Pines distributing reservoir. The wash water is controlled by hydraulic valves connected to the high pressure. These valves have no automatic control and for a number of years considerable trouble was encountered because of creeping of the valves. To overcome this difficulty, a valve control device was made (see figs. 1 and 2).

No doubt, some of you have had experience with hydraulic control valves creeping either to an open or closed position. The use of this device prevents the valve from opening during the washing of filters except as the controller is operated, thus eliminating danger of excess flow of water, upsetting the stratification of the filter media, and making it necessary to empty the filter shell and restratify the rock, gravel and sand.

Previous to the use of this device the operator would sometimes be called to the telephone after starting the wash water and on returning would find that the valve had crept open and the stratification

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A symposium given at the California Section meeting at Riverside, California, October 28, 1938, by: Fred R. Lauterbach, Division Foreman, San Dieguito System, City of San Diego, Calif.; W. G. Curry, Southern California Water Company, Los Angeles; C. M. Pinkham, Chief Operator, Filtration Plant, Santa Barbara; M. Edmiston, Beverly Hills Water Dept., Beverly Hills, Calif.; and Henry C. Myers, California Water and Telephone Co., National City, Calif.

of the filter media disturbed. A proper use of the controlling device prevents this condition.

In the operation of washing a unit, the operator first closes the influent and effluent valves, opens the sewer valve, then sets the device on the wash water or effluent valve, from which is drawn the clear water for washing the unit. He then screws the gadget up

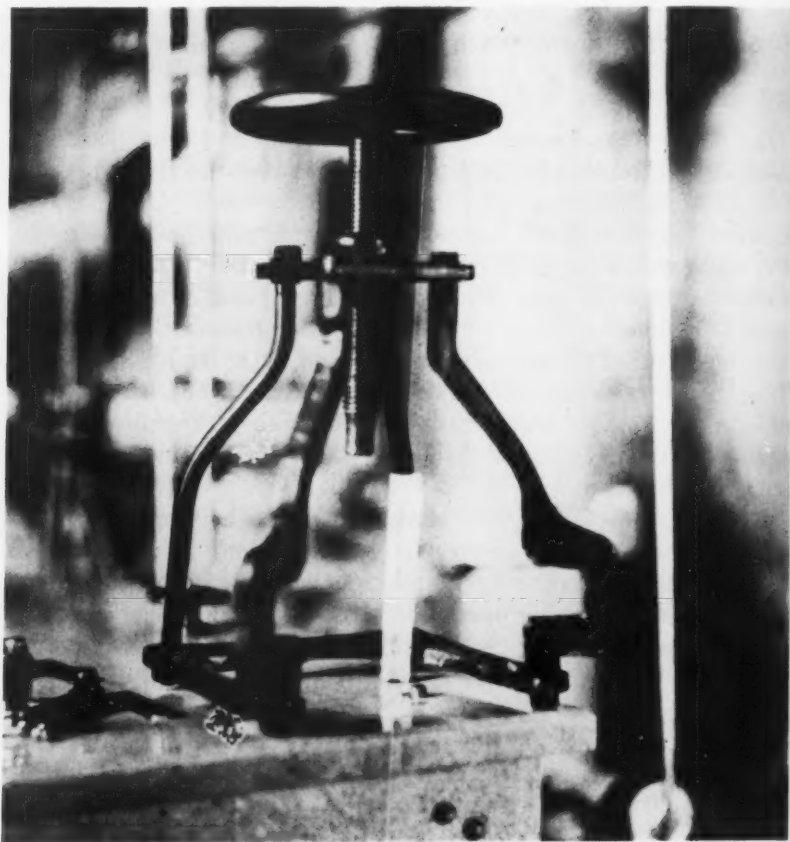


FIG. 2. The Valve Controller in Place

to the tail rod of the valve and sets the control to open position. He starts to wash by turning the wheel on the controller to permit the valve to open slowly until the wash rate reaches 1,600 gallons per minute, which takes about three minutes. After five minutes of full flow, the operator closes the valve slowly so as not to throw a surge on the plant. In opening, sometimes a hydraulic valve will stick.

The operator then swings the control lever backward or forward to start it to open. When it does start it may open fast, but with the controlling device in place this danger is avoided and a sudden surge of water prevented.

Our operators have been warned that to be caught washing without this gadget will result in serious reprimand and possibly loss of job.

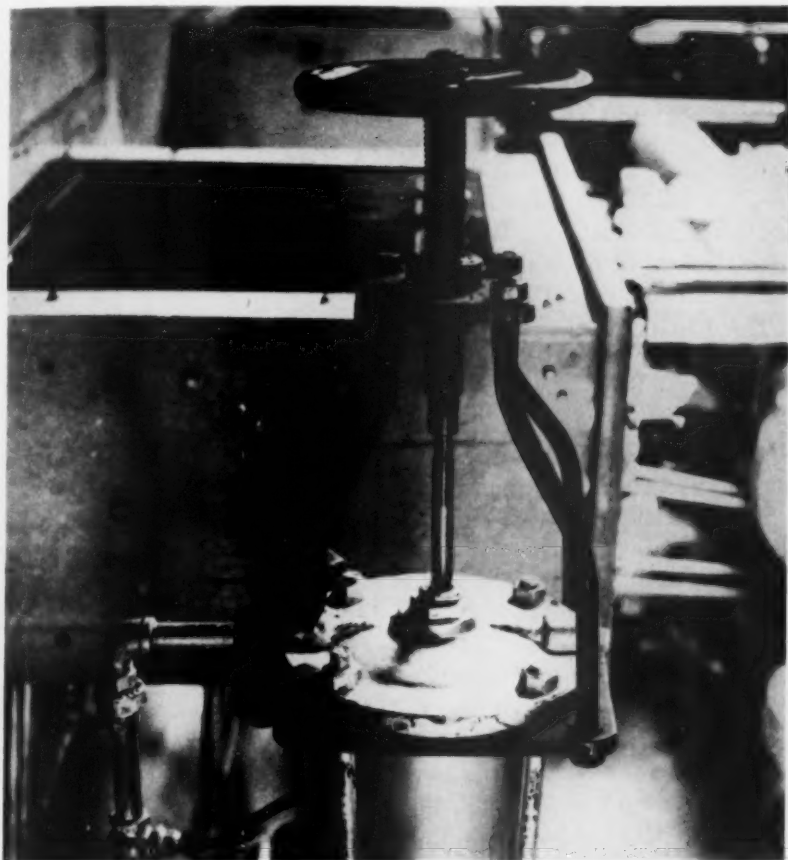


FIG. 1. Hydraulic Wash Water Valve Control Gadget

This controlling device has proven to be a safety measure against unnecessary expense. Since using it the repair bills for restratifying the filter beds have been reduced about 75 per cent.

The device was made in the City Shops after the idea was discussed with the machinist and he had taken measurements at the plant. The cost of material and labor was about \$25.

## Automatic Equipment

*By W. G. Curry*

Mechanical equipment will be dealt with below by reference to one particular plant where the treatment includes aeration, chlorination, coagulation, filtration, and de-chlorination. These operations are performed with a minimum of man power; in fact, this particular plant is left in operation, and unattended, during the night hours. I shall attempt to describe the operation and control of the equipment of the plant, from the time the water is pumped from the wells until it is released into the distributing system.

In our case, the principal necessity for the automatic control of equipment is the fact that storage space for the finished product is very limited. The plant must, therefore, respond, almost immediately, to the demand. We have also found it possible, with this arrangement, to have the operators attend as many as four or five plants, with no loss of efficiency.

The demand on the plant is first reflected in our storage reservoir, or clear well. In this clear well, we have float switches which start and stop the well pumps. When one or all of the well pumps start to operate, several pieces of mechanical equipment begin to function, in unison. These include a blower, coagulant pumps, and chlorinating and flocculating equipment.

Since aeration is the first treatment the water receives, I shall describe the aerating system that we are using. The water is pumped from the wells into the top of the aerating tank. We are using a Connersville type air blower, and diffusing the air through a carborundum grid system. This blower is connected into each of the well circuits, and starts operating immediately when the well pump starts. The grid system is near the bottom of the tank and the water has to travel from the top of the tank to below the grid system, where the outlet to the flocculating tank is located. During the period of travel downward in the tank, the finely diffused air is traveling upward and releasing such gases as hydrogen sulfide, carbon dioxide, and methane. We have found, with this type of aeration, that the pH of the water is raised from 7.5 to approximately 8.0 when all of our wells are in operation, and slightly higher than 8.0 when less water is being treated.

Just as the water leaves the aerating tank, the coagulant, ferric chloride, is added. The ferric chloride is fed by Proportioneer

chemical pumps, one for each well pump. These Proportioners, by means of relays, start to operate as the respective well pumps start production. Each Proportioner is set to pump the amount of ferric chloride required to treat the water produced by the well it serves. Until recently, we experienced considerable difficulty in feeding the chemical because small particles of dirt or tank lining lodged under the rubber check valves in the pump. Our mechanical department has eliminated this difficulty by building a ferric chloride filter. Since the installation of these filters, we have had uninterrupted feed.

After the coagulant is added, and just before the water enters the flocculating tank, the chlorine is added, in solution. We find it necessary to chlorinate very heavily at this particular plant, and to carry a heavy chlorine residual all the way through the plant into the clear well. The chlorinating is done with an injector-type chlorinator. Only one injector is used, but there is an individual compensator for each well. The automatic feature of the chlorine feeder is a group of solenoid switches that operate chlorine valves, and are connected in each well circuit in the same manner as the ferric chloride pumps. In this case, the chlorine dosage for each well is set on the compensator connected with that particular well.

The flocculating mechanism consists of a Turbo flash mixer, which operates when one or all of the wells are in operation, in a manner similar to the blower.

A description of the sedimentation basin is omitted because there is no mechanical feature in this part of the treatment.

After the water leaves the sedimentation basin, it proceeds to the rapid sand filters. The flow of the water through these filters is controlled by basin level mechanisms. Each filter has a float that rides on the water and operates a pilot valve which opens or closes a hydraulic rate controller valve, as necessity demands.

The effluent of the rapid sand filters goes to the clear well, which is our storage basin for treated water. The water is not yet a finished product, however, for the reason that it has a high chlorine residual. The de-chlorination of the water is the final operation in the treatment plant. The method of de-chlorination will be described below.

High speed booster pumps are employed to convey the water from the clear well. These pumps are operated by pressure switches, which, of course, respond to the fluctuation in the demand on the plant. The booster pumps deliver the water to a battery of pressure-type activated carbon filters, where the chlorine is absorbed. The

effluent of the carbon filters is the finished product, and the water goes directly into the distribution system.

At some of the plants we are operating, we de-chlorinate with sulfur dioxide gas instead of with carbon filters. The control of the feed of sulfur dioxide at these plants is the same as the control of chlorine previously described, with the exception that the solenoid switches are not on the well circuits but are on the booster pump circuits. The point of application of the sulfur dioxide is just prior to the booster pumps.

The manual operating duties at these plants consist of back-washing filters, and lubricating and maintaining the mechanical equipment. The plants have been operating over quite a long period of time, and, as before stated, they operate during the night hours, unattended, for periods of from eight to sixteen hours without supervision—and as yet we have had no serious failure. The mechanical equipment must, of course, at all times be kept properly lubricated and cleaned for efficient operation.

In conclusion: It is my opinion that the smaller water treatment plant can be satisfactorily operated, to a very great extent, with automatically-controlled equipment.

### **Chemical Storage and Feed**

*By C. M. Pinkham*

In writing this paper on chemical storage and feed, I will try to point out some of the problems encountered at Santa Barbara, and how thus far, they have been overcome. It is my sincere hope that designers of treatment plants in the future may be able to profit, to some small extent at least, by these and other operators' experiences.

The chemical storage and feed setup at Santa Barbara is a radical departure from the usual layout. By this I mean that the chemicals are stored and fed from the lowest point in the plant. The storage and feed is done from 15 feet beneath the ground level while the flocculators, clarifiers, and filter beds are 10 feet above the ground.

Three main reasons contributed to this design. First, in order to follow out Santa Barbara's low Spanish architecture it was desired not to have a tall storage tower (see fig. 1). Secondly, the location permitted storage room in the basement at low construction cost. Third, gravity flow water of 230 lb. was available to use in ejectors.

With this layout, the chemicals, of which we use approximately 25 tons of lime and 10 tons of soda ash each week, are received by

truck. The lime is hauled in paper bags and the soda ash in bulk. The lime bags are emptied from the truck bed into a small hopper and the soda ash is pushed and hoed into a chute leading to a small road hopper.

From the road hoppers the materials are conveyed to the large storage bunkers by screw conveyors. From the storage bunkers they are again conveyed by screw conveyors to the small feed hoppers located directly over the dry chemical feed machines (see fig. 2). These materials have been found to work very well in screw con-

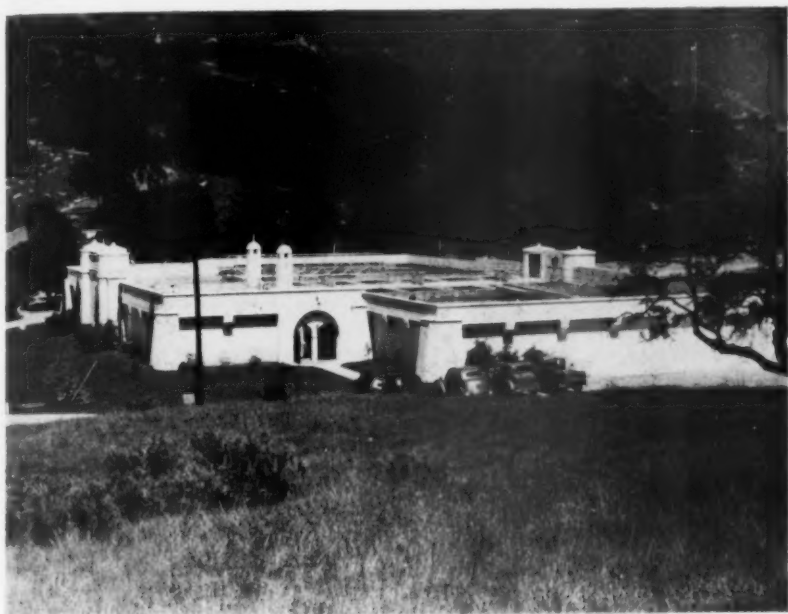


FIG. 1. View of Entire Plant. Note absence of any large high storage tower

veyors, the only trouble experienced being that of dust when the conveyors are not air tight. The hydrated lime used is of such fineness that 98 per cent passes a 325-mesh sieve and from this comes a problem in dust elimination.

To eliminate this dust, the conveyors and bunkers were caulked as tightly as possible. Then a means of removing the dust ladened air from the bunkers during their time of filling was found necessary. For this purpose a dust arrester system was installed consisting of a cloth filter equipped with a 200 cu.ft. per minute blower connected

so as to transmit the dust laden air from the bunkers through the cloth filter and then exhaust it out of doors. The cloth filter removes the main portion of dust from the air and this dust can be used or wasted depending upon its cleanliness. This arrester system is also piped to the place where the trucks unload so as to assist in keeping dust away from the men during unloading, and to various points along the chemical storage room where it may be used as a vacuum sweeper on the floor.

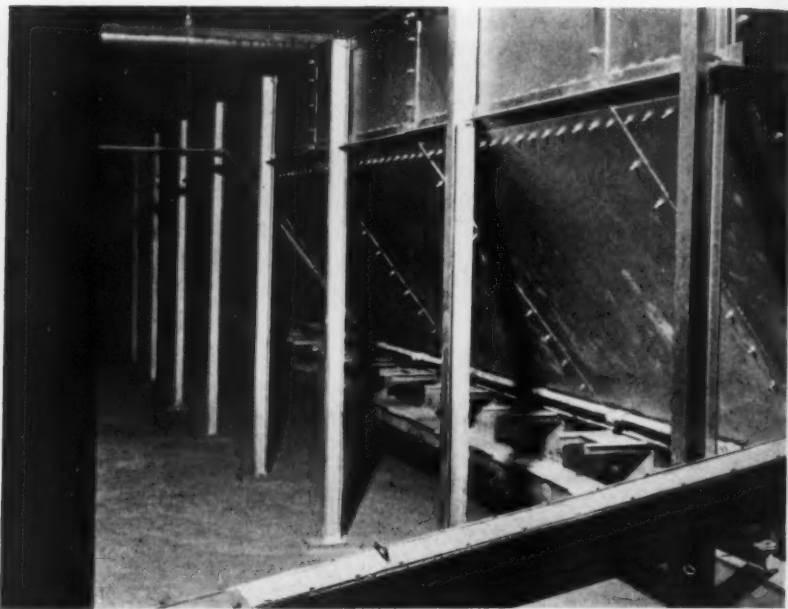


FIG. 2. Fifty-ton Soda Ash Bunker, with 6-inch screw conveyor to supply chemical feed machine

The usual trouble of funneling of hydrated lime was encountered and corrected by the use of a variable electric vibrator fastened to the side of the bunker. This vibrator was found to work much more satisfactorily than the blade type agitator. The vibrator eliminates most of the funneling and keeps the lime packed sufficiently to eliminate its running like water as it will sometimes do when loose.

The feed problem at Santa Barbara is unique in that after being measured in dry chemical feed machines, (shown in fig. 3), the chemicals are put into solution and injected into a flash mixing drum

located beneath the flocculators (fig. 4). These ejectors force the chemicals in solution into the mixing drum against a 25-foot head. The ejectors are of the Penberthy make and  $1\frac{1}{2}$  inch in size. They are operated on 200 lb. water pressure and were found to be unsatisfactory at a pressure lower than 150 lb.

Experience has proven that the ejectors work better for this purpose when they are set lower than the elevation of the solution to be ejected and are allowed to draw a little air as well as the solution.

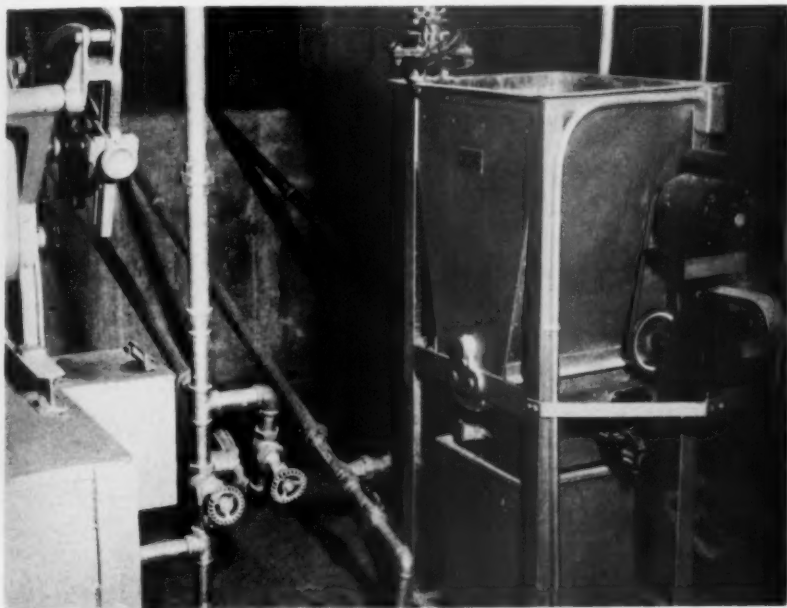


FIG. 3. Dry Chemical Feed Machines, with ejectors elevating chemicals in solution to mixing drum

The  $1\frac{1}{2}$ -inch pipe lines used in connection with the ejectors gave trouble through scale formation. Two sets of lines were connected to each solution tank so as to maintain feed while one was being cleaned.

The soda ash lines plug several times daily and are connected to a water heater for cleaning. The cleaning requires turning water of about 170 degrees F. through them for about 5 minutes or, in quantity, about 25 gallons of hot water. The hot water dissolves the coating and the line is again ready for service.

The lime lines plug about every two weeks and are taken apart and cleaned manually, either by pushing a smaller sized pipe through them or by allowing the coating to dry for several days and then striking the pipe with a hammer which flakes off the coating.

The alum pipes plug about once a month and require the same manual treatment.

The feed lines are 22 ft. long and enter the side of a horizontally set drum 12 ft. long and 4 ft. in diameter. This drum was designed

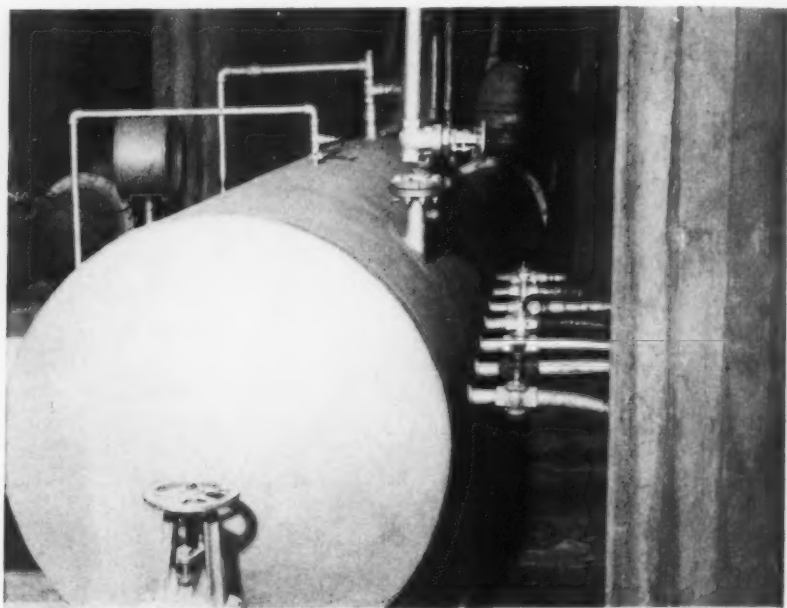


FIG. 4. Mixing Drum Showing Air Bleed Lines on Top. Tangential high pressure lines were eliminated. Lines entering horizontally are chemical solution feed lines.

to give a flash mixing period to the main body of water and chemicals. For mixing it was equipped with three high pressure water lines striking the drum at a tangent so as to give a rolling motion to the water. It was found that this gave too violent an action and had a tendency to break up the floc rather than being an advantage through mixing. The mixing seems to be adequately done by the water from the ejectors.

The air accumulated in this drum from the operation of the ejectors

was found to be another harmful factor in the production of good floc. A bleeder was installed on the drum to release the air as it accumulated. The result was a much larger and faster settling floc.

Upon leaving the mixing drum, the main body of water with the treatment chemicals is conveyed through about 40 feet of large pipe to the flocculators. Here again was found a problem in soft scale formation. To remove this scale, small stop cocks were cut into the large pipe at various points and high pressure water is run through them occasionally, allowing the force to break the scale loose.

The Santa Barbara setup was originally designed for quick lime and several different brands were tried out. It was found that the slight additional cost for available calcium oxide, when purchasing hydrated lime, was more than offset by the advantages in feeding and in results with the hydrated lime. When using quick lime, the solution feed lines plugged very rapidly and the scale formed was of such nature that cleaning the pipes was impracticable. At this time too, it was found that due to uneven slaking there was a deposit of very heavy sludge in the flocculators. This sludge necessitated unwatering the flocculators and cleaning them by hand. This in itself was a very slow and costly operation.

The Santa Barbara Plant has proven that chemical storage and feed can be worked from beneath the main units of a treatment plant, and also, that many additional problems over those of a gravity feed system, are involved.

### **Anhydrous Ammonia and Filter Results**

*By M. Edmiston*

These filters are of the rapid sand type, and pre-chlorination is practiced at all times. In 1928 when the Beverly Hills plant was put into service, we had chlorine only for our filters. At that time we were carrying a chlorine residual of .05 to .08 parts per million at the filter effluent with the result of filters clogging from bacterial growths, mud ball, and the sand surface cracking very badly. We were kept busy cleaning filters with a strong solution of caustic soda followed by a chlorine bath, applied by the method of first washing the filter, then drawing the water below the surface of the sand bed and sprinkling the caustic soda evenly over the filter  $1\frac{1}{2}$  to 3 lb. per 10 sq. ft. of surface, then flooding with water to a depth of about 20 inches. When the caustic soda has dissolved, the solution is drawn down

through the sand bed with only a few inches of water over the top of the sand and allowed to stand for a period of 8 to 24 hours, the sand bed being shaken up by air two or three times on each shift. The filter is then given a thorough washing followed by a strong solution of chlorine. This is applied by a portable chlorinator and left stand 10 to 18 hours. The filter is again washed and put into service or drained and dried out until used again.

In 1930 we began the use of anhydrous ammonia with very pleasing results. By this method we were able to increase our chlorine residual up to .30 p.p.m. in the filter effluent, the mud balls began to disappear, and the bacterial growth which caused the surface cracking was nearly all gone and the taste and odor problem was lessened very much with very little need for the caustic soda treatment. But we do use some caustic soda as we have made it a practice when a filter is taken out of service to clean it at once. Ordinarily a strong chlorine bath is enough, but at times it is necessary to use caustic soda to clean the surface of the sand bed. We have found that a sack of copper sulfate hung in the channel ahead of the filters helps to keep the filters in proper condition.

In 1931 a carbon dioxide generator was installed feeding a dose of .75 to 1.25 grains per gallon. The result was that sand grains were cleaner because there was very little incrustation left. The chlorine residual was raised to about .35 p.p.m. with no mud balls, no surface cracking and very little bacterial growths in the filters. We now use activated carbon ahead of the filters for the control of taste, odor or an excess amount of chlorine. But once a taste or odor develops in the filter bed, a much stronger method has to be used. The quantity of chemicals used to properly treat a filter depends upon the condition of the filter bed. Filters need a great deal of care and attention to see that the effluent water is at its best at all times.

One important duty is to float the filter beds while washing. This is accomplished by pushing a long pole or small pipe down through the sand bed to the gravel to see that the sand is all in suspension and that the lower gravel bed has not been disturbed. If the gravel is in ridges or peaks it should be raked or leveled with a long handle rake while washing because at this time the sand is all in suspension. The surface of the sand bed should be kept as level as possible. The influent valve should be opened very slowly so as not to riffle surface of sand bed after washing.

## Stabilizing Lime-Softened Water

*By Henry C. Myers*

A lime softened water contains calcium carbonate in the colloidal form. This calcium carbonate, unless previously removed or transformed to a soluble calcium compound, such as the bicarbonate or sulfate, tends to precipitate out and in so doing incrusts filter sands, water pipes, and hot water heaters with a coating of calcium carbonate. Such a water is said to be unstable. In each softening plant some method must be adopted whereby the water before leaving the plant will be freed of its excess calcium carbonate. The object of this paper is to explain the manner in which this removal is accomplished at the South Basin Plant.

The water being softened is well water and the characteristics are such that lime alone is required in the softening process. About 63 per cent of the well water is overtreated with lime. This excess treated water, after a mixing period, is followed by settling in a Dorr Clarifier. The effluent from the clarifier is reunited with that portion of the raw water which is untreated with lime. Ferric chloride is added as a coagulant. Flocculation occurs, followed by sedimentation, and finally the water is filtered through rapid sand filters.

The filtered water is considerably softer than the sedimentation effluent, due to the tendency of the colloidal calcium carbonate to precipitate out during filtration. The following experiments were made to show just what was happening in the filter beds. Samples of the sedimentation effluent and of the filtered water were taken. After first filtering the sample of the sedimentation effluent through paper to remove all the floc, an analysis of each sample was made. The results are shown in table 1.

These results show a reduction in total hardness of 47 p.p.m. expressed as calcium carbonate. It may be seen that the reduction in hardness is all carbonate. The difference between the methyl orange alkalinities gives the same result as the difference in total hardness. Then, to determine the degree of softening which occurs in the filter bed, only the methyl orange alkalinities are required.

The results of experiments showing the relation between the pH and alkalinity when filtering through various depths of sand are shown in table 2. These results were independent of the rate of filtration over the range tried, from 0.33 to 4.00 gal. per sq.ft. per

min. Although the water passing through thin layers of sand was quite turbid, there was a marked change in pH and alkalinity.

As a result of this softening in the filters the size of the sand grains continually increases. This could be reduced by stabilizing the water before filtration, either by the use of carbon dioxide or sulfuric acid. With the use of carbon dioxide the colloidal calcium carbonate would be transformed to carbonate hardness. Should sulfuric acid

TABLE 1  
*Comparison of Sedimentation Effluent and Filtered Water*

	SEDIMENTATION EFFLUENT	FILTER EFFLUENT
pH.....	9.3	8.6
Phenolphthalein alk.....	33 p.p.m.	6 p.p.m.
Methyl orange alk.....	110 p.p.m.	63 p.p.m.
Calcium.....	50 p.p.m.	32 p.p.m.
Magnesium.....	14.5 p.p.m.	14 p.p.m.
Total hardness.....	185 p.p.m.	138 p.p.m.
Carbonate hardness.....	110 p.p.m.	63 p.p.m.
Non-carbonate hardness.....	75 p.p.m.	75 p.p.m.

TABLE 2  
*Character of Filter Influent*

pH.....	9.4
Phenolphthalein alkalinity.....	36 p.p.m.
Methyl orange alkalinity.....	105 p.p.m.

	DEPTH OF SAND (INCHES)							
	3	6	9	12	15	18	21	30
pH.....	9.1	8.9	8.9	8.8	8.7	8.7	8.7	8.7
Phenolphthalein								
Alkalinity (p.p.m.)..	21	18	16	12	10	10	10	10
Methyl Orange								
Alkalinity (p.p.m.)..	82	74	69	67	66	63	63	63

be used there would be an increase in non-carbonate hardness. In either case there would be an increase in hardness. The filtered effluent would be no softer than the effluent of the sedimentation tank. For this reason it would be necessary to increase the lime dosage and possibly use a certain amount of sodium carbonate in order to produce a water with a hardness not greater than was formerly had.

That the water as it leaves the filters is quite stable is evident from the result of the calcium carbonate stability tests, from the lack of complaints on the part of the consumers and from frequent inspection of water meters and pipe line cuts.

Originally the sand had an effective size of .35 mm. and a uniformity coefficient of 1.68. The effective size has increased steadily until at the present time, at the end of two years of operation, it is 1.2 mm., while the uniformity coefficient has steadily decreased until it is now nearly unity.

After the effective size of the sand became about 1 mm., sand expansion during the wash period became practically nothing (originally it had been about 30 per cent) even though the wash water rate had been increased to 38 inches rise per minute. As the sand grains become larger and the expansion during the wash period less, the coating formed is much softer and the surface quite rough. This is particularly true for a top layer of about 6 inches. The grains in this top layer are considerably larger than those of the deeper sands. This is attributed to two factors. First, laboratory tests have shown that nearly all the colloidal lime is removed in a very few inches of filtration, and second, as the sand grains become larger and the wash rate is increased the tendency is for the larger grains to be pushed to the top because of their greater surface areas. The sand grains do not tend to become cemented together. They simply enlarge.

Since the plant was first put in operation the filters have washed well. There has been no increase in the amount of wash water used. That amount never exceeding 2 to 3 per cent of the total output. The filters wash uniformly and filter uniformly. The quality of the filtered water is excellent, having a turbidity less than 1 p.p.m. at all times.

Usually the filter runs are less than 24 hours due to the practice of filling the storage reservoir and then shutting down for a period during the night. When the plant is shut down filters are washed immediately, thereby avoiding the possibility of forcing material down into the filter beds, which might be the case if dirty filters were placed in service. However, filter runs of more than 70 hours have been had between washings when filtering at the rate of 2 gal. per sq.ft. per min. When filtering at the rate of 4 gal. per sq.ft. per min., runs of 14 to 15 hours are had. It appears that the larger sand grains favor the higher filtering rates.

Because of the fact that the filter sand is used as a means of stabil-

izing and softening as well as filtering, a close check is kept for traces of turbidity in the filtered effluent. Filters are washed by turbidity measurements regardless of loss of head through the filter.

The success of filtration when using large sized sands is due to the quality of the water placed on the filters. This water always has a turbidity of less than 10 p.p.m.

In the conditioning of the water for filtration, split treatment is resorted to. Experiment has shown that at this plant best results are obtained when 37 per cent of the raw water is by-passed about the overtreated portion. The two portions are reunited as the coagulant is added. In this way a maximum removal of magnesium occurs in the clarifier tank. A secondary softening due to the excess of hydroxide in the overtreated portion reacting with the bicarbonate in the by-passed portion occurs during the coagulation period. This secondary softening removes calcium only.

Due to the secondary softening a good nucleus is formed for the floc to build up on and during low rates of flow, when the retention period is greater, no coagulant is necessary.

The pH of the clarifier effluent is maintained at 10.6 while that of the sedimentation effluent is kept at 9.4 (pH 9.4 being the point where calcium carbonate is least soluble). As a result of the method of treatment there is very little material for the filters to remove.

From the experience at the South Basin Plant it appears that in a small water softening plant, the incrustation of filter sands can be used as an economical aid in stabilizing and further softening the treated water. The cost of replacing the filter sand every two to three years is the entire expense for stabilizing the water. The results obtained more than compensate for the additional trouble and cost of periodically overhauling the filter units.



## Meter Settings and Controlled Compounding of Meter Batteries

*By L. S. Vance*

**I**N LOUISVILLE during 1934 and 1935, some 22,000 tile meter vaults were placed on existing service pipe connections in the sidewalk between the curb and property line. This necessitated the addition of three wiped solder joints, one each for the two bent meter couplings and one to attach the necessary lead pipe extension (to form the meter riser in the vault) to the existing lead service pipe. There were already four wiped solder joints on the original lead service; one at the corporation stop at the main in the street; two at the curb stop, just inside the curb; and one at the property line. The curb stops are provided with slip extension key tubes through which the stop may be operated. The meter vault consists of a straight piece of 22-inch diameter tile provided with a cast-iron cover and lid with pentagon nut operating a worm type lock.

Following as well as during the extremely cold winter of 1935-36 a great deal of trouble was experienced with frozen meters and leaking service pipes. It was directly attributable to the large number of wiped joints on lead service pipes, to curb stop key tubes heaved by frost action, and to frozen meters which were the result of haste during installation when laborers backfilling the vault excavation, in order to obviate removal of too much excess dirt, also backfilled some inside the tile vault.

The flooding of about 70 per cent of the area of the city during the great flood of the Ohio River in 1937 also subjected these lead service pipes to additional dislocations and strains, causing other leaks.

To eliminate as many buried service pipe joints as possible in future installations, the use of copper tubing for service pipes in

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A paper presented at the Indiana Section meeting at Indianapolis, April 26, 1939, by L. S. Vance, Chief Engineer and Superintendent, Louisville Water Company, Louisville, Kentucky.

sizes from  $\frac{5}{8}$ -inch through 2-inch was started, late in 1936. Flared compression type joint fittings were used throughout on the  $\frac{3}{4}$ -,  $\frac{3}{4}$ -, and 1-inch sizes. The curb stop was moved into the vault and through the use of a combination angle type stop and meter coupling (developed by the Ford Meter Box Company) on the meter vault inlet and a bent meter coupling and iron pipe thread to copper tubing adapter on the meter outlet, all but two of the buried pipe joints of a complete service connection were eliminated. One of these joints is at the main in the street and the other is the property owner's joint at the property line. The meter is set on the riser pipes formed by merely bending the copper tubing up into the tile vault. After a little over two years of operation with this type of installation we are almost ready to recommend it as most satisfactory. Close to 3,500 such installations have been made up to this time.

#### Record of Early Battery Installations

Back in 1890, in order, probably, to supply sufficient water to the Louisville & Nashville Railroad at their 10th Street Yard, two 6-inch meters were installed in parallel on the 6-inch service pipe. This was probably the first meter battery installation in Louisville.

Later battery installations were installed as follows:

1901—Six 6-inch meters and four 3-inch meters on a 16-inch service to the Louisville Railway Company's Electric Generating Plant.

1904—Two 6-inch meters on a 10-inch service to the L. & N. R. R. Yards at South Louisville.

1909—Two 6-inch meters on a 12-inch service to the Louisville Gas & Electric Company's Steam Generating Plant.

1913—Two 4-inch meters in parallel on a 6-inch service to the Seelbach Hotel.

Our meter repairman of that period, now service foreman, was quick to learn the advantage of being able to make repairs on battery installations without interrupting water service and was careful from then on to install valves and test tees for each meter. By 1924, with the city in general still on a flat rate basis of payment for water service, the long up-hill struggle of universal metering was started. By this time the installation of batteries of meters had been extended to 4- and 3-inch services, using three 2-inch meters in parallel and two 2-inch or three  $1\frac{1}{2}$ -inch meters respectively.

As the percentage of active services metered gradually climbed and as the percentage of total water pumped which was registered by

meters also climbed, other means of increasing and maintaining accounted for water were investigated. The lowest rates of flow at which the larger size single meters would register accurately and also the rates at which simple batteries would register accurately were apparent from reading the A. W. W. A. specifications. Beginning in May, 1933 some means of compounding the batteries already in use were investigated, that is forcing all water of low rates of flow through one meter and allowing flow through the remaining meters of the battery only when the rate of flow was sufficient to be divided and still be well above the minimum accurate rate for each of the multiple units.

Counterweighted lever check valves were tried in the spring of 1932, but due to their cost, their use could be justified only on the larger sized installations. Several have been used to compound existing single turbine or velocity type meters with good success.

The compounding of batteries of 2-inch meters was tried using ball check valves. Interchange of information between companies had indicated that the City of Memphis early in 1936 had tried standard flap check valves for that purpose, without sufficient result to justify the trouble of installation.

In the summer of 1936 on test in the meter shop, 2-inch flap checks with added weights to hold them closed to a point of higher differential pressure were investigated. Tested without weights almost identical results were obtained, however the differential pressure required to open the checks was not caused by sufficient flow through the unchecked meter to assure accurate registration of the flow when divided between the three meters of the battery.

### Spring Controlled Check Valves Tried

In September of 1936 the local representative of a meter company in Louisville, who had been very much interested and of considerable help in our trials and errors at compounding battery arrangements, suggested the possible use of spring controlled check valves used by his company in their gasoline handling equipment. One valve was a straight through spring controlled poppet check. This was eliminated due to the high friction loss required to hold the valve open. The other valve was an angle type check also controlled by a spring. However, in this valve the spring, with the flap closed, is designed with a long lever arm to hold the valve closed; though on opening this lever arm is decreased even though the spring is more and more

stressed. With the flap wide open the spring acts to close the valve with only a very short lever arm and the loss of head, due to water flow holding the valve open, is therefore low.

These angle check back pressure valves, being made in the form of street ells, fitted neatly into our standard battery setup (see fig. 1). Meter connection tees in the headers on the inlet and outlet sides of batteries are set with outlets up so that with the use of street ells the three parallel lines of connecting piping including the meters can be installed with less rigidity and therefore less strain on pipe, fittings and meters.

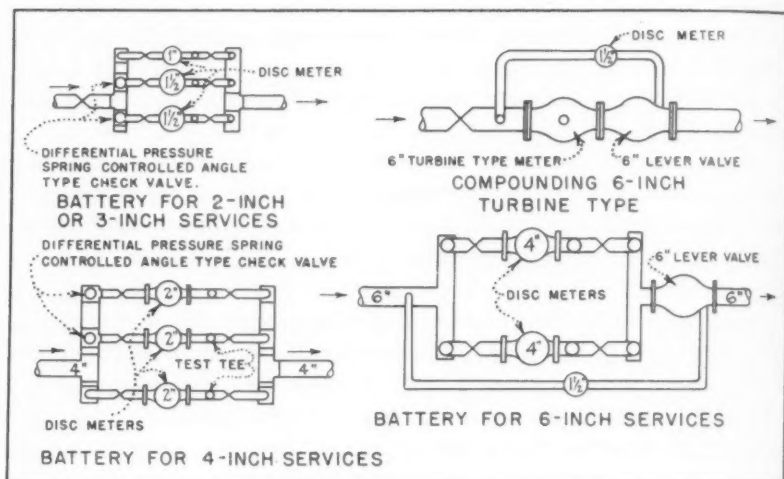


FIG. 1. Standard Battery Setups

Each meter of the battery is provided with its individual test tee, and isolating valves are provided so that each meter can be repaired, tested or exchanged without interfering with the flow through the remaining meters to the consumer.

Battery installations both with and without controlling angle check valves have been installed in series with compound meters, merely for checking. Unfortunately in both installations the meter capacities were larger than the actual service demands required. In one instance on a large office building a 4-inch compound meter registered 1,030,000 gallons compared to an uncontrolled battery of three 2-inch meters registration of 613,000 gallons in two and one-half months.

Angle type spring controlled check valves were installed on two of the three 2-inch meters of the battery and during the next eight months the battery registered 3,920,000 gallons compared to the compound registration for the same period of 3,821,000 gallons.

Louisville, through lack of control of service sizes on original installation in the past, is either blessed or damned, depending on the point of view, with an excessive number of 1-, 1½- and 2-inch

TABLE 1  
Data from Tests

REMARKS	TEST NO.							
	1	2	3	4	5	6	7	8
	Check not open	Check just opened	Check opened	Check just closed—change point decreasing flow	Rate of flow just before check opens	Same valve setting as Test 5, but check valve has opened. Change point increasing flow	Pressure check. (Check closed. 65 lb./sq. in.; Check opens 64 lb./sq. in.; Both Meters operating 66-67 lb./sq. in.) Discharge valves set as in No. 5 and No. 6	Full flow
½-inch Meter, Total								
Flow, in gal. ....	50.3	35.7	35.8	49.6				32.5
Rate, gal/min. ....	6.4	9.1	9.2	8.2	11.6	8.4		30
¼-inch Meter, Total								
Flow, in gal. ....	0	14	14.3	0				26.2
Rate, gal/min. ....	0	3.5	5.8	0	0	2.2		22.2
Calibrated Tank, in gal. ....	50.5	50	50	50				59±
Pressures lb./sq. in.								
Before .....	73	73	72.5	73	72.5		72	73
During .....	70	67.5	67.5	69	65	68		14
After .....	73	72.5	73	73	72.5	73.5	72	73

service pipes to residences and other relatively small consumers of water. Metered water rates of the past and unfortunately of the present, provide for no varying minimum payment dependent on meter size. So there has been no economic incentive for the new consumer to request a service installation, as to size, commensurate with his actual needs. Architects and plumbers have the misconception, in Louisville, that a flush valve type of toilet will not function properly on a service smaller than 1½-inch in diameter. In the past

they requested, and were given,  $1\frac{1}{2}$ -inch services. In residences of this type 60 to 70 per cent of the consumption is actually at rates of flow of five gallons per minute or less. Unfortunately the same

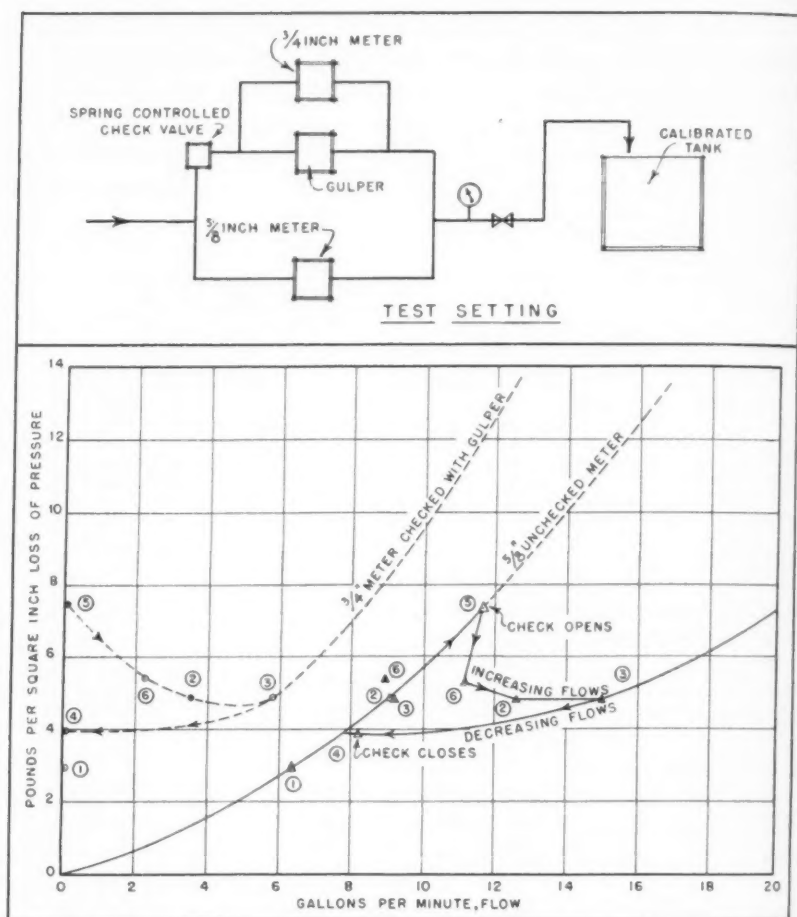


FIG. 2. Diagram, and graph and table of results of check test of controlled battery setup with spring check valve, July 19, 1938.

psychology was evident in connection with service installations to apartments and office and store buildings in requesting 2-, 3- and 4-inch services. Two years ago we replaced a 4-inch meter with a controlled battery of two  $1\frac{1}{2}$ -inch meters checked with spring con-

trolled angle checks and one 1-inch meter unchecked. After 18 days the 1-inch registered 108,000 gallons and the checked  $1\frac{1}{2}$ -inch meters showed 300 and 100 gallons respectively. The total registration increased this consumer's monthly water payments 100 per cent.

It is our feeling, in Louisville, that a meter installation of  $1\frac{1}{2}$ -inch or larger should not be considered permanent or satisfactorily sized or arranged, without having had before final and permanent installation, a recording register test to show the actual water demand. This requirement of procedure entails considerable expense; however, considerable unregistered water can flow through a meter sized too large for the actual demands.

In July, 1938, time was finally found to attempt to check the operation of the angle type spring controlled check valve in the meter shop. The hoped for result was to alleviate our worries as to the inaccuracies of the controlled battery at the change over point and to attempt to prove that there was no fluttering of the spring controlled check at this critical point on the loss of head curve.

A battery of one  $\frac{3}{4}$ -inch meter connected through a gulper, with this group checked or controlled by a 2-inch angle type spring check valve with a  $\frac{5}{8}$ -inch meter unchecked in parallel was set up as shown in fig. 2. Data obtained from the various tests are also shown in table 1.

The results plotted with gallons per minute total flow against pounds per square inch loss of head show graphically the lack of check valve flutter on opening and closing. The valve did not open to allow a division of flow between the two meters on increasing rates of flow until the loss of head equaled  $7\frac{1}{2}$  lb. per sq. in. On decreasing rates of flow the spring controlled check valve remained open until the head loss had dropped to 4 lb. per sq. in. The Ford gulper was included in the test setup in order to determine and measure any flow if the valve should flutter.

To date 218 of these valves in the 2-inch size and 18 in the 3-inch size have been installed in battery installations. These valves, together with one 4-inch and seven 6-inch lever type counterweighted check valves, control the battery of meters installed on 180 services. There remain about 109 simple battery installations, which it is our intention to "compound" as described above.



## ABSTRACTS OF WATER WORKS LITERATURE

**Key.** 30: 402 (Mar. '38) indicates volume 30, page 402, issue dated March 1938. If the publication is paged by issues, 30: 3: 402 (Mar. '38) indicates volume 30, number 3, page 402. Material inclosed in starred brackets, ★[ ]★, is comment or opinion of abstractor. Initials following an abstract indicate reproduction, by permission, from periodicals as follows: *B. H.*—*Bulletin of Hygiene (British)*; *C. A.*—*Chemical Abstracts*; *P. H. E. A.*—*Public Health Engineering Abstracts*; *W. P. R.*—*Water Pollution Research (British)*.

### WELLS AND GROUND WATER

**The Administrative Control of Ground Water.** ANON. *Am. City* 53: 10: 75 (Oct. '38). Portion of a report made by a special committee of the Texas Planning Board. States importance of ground water control in Texas and the problems pertaining to its regulations. Stated that three out of four persons in Texas depend upon wells and springs for their water supply. Two-thirds of the population in cities over 2500 population goes to make up this group. Eight out of every ten urban cities in Texas depend upon wells and 95% of the rural population use wells or springs. Industrial users are in about the same proportion as the urban population. Irrigation of land for cultivation of rice is provided by wells near Beaumont and Houston. Legislation for ground water control must not only be consistent with existing surface laws, but it must be such as to benefit areas in need of regulations, and at the same time work no hardship on sections where regulation is now unnecessary. The laws of ground water control relative to the decision of the English courts in 1843 and the ruling by the New Hampshire Court in 1862 are given; also, as a part of the article is the status of the laws relative to underground waters in the various western states as published by Harold Conkling in the *Transactions of the A. S. C. E.* (See abstract *J. A. W. W. A.* 30: 204 (Jan. '38).—*P. H. E. A.*

**Conservation of Water Through Recharge of the Underground Supply.** A. T. MITCHELSON. *Civ. Eng.* 9: 163 (Mar. '39). Water spreading as a means of conserving surface flow for storage under ground, first practiced in Colorado in 1889, is practiced in suitable areas in southern California. Requirements for suitability include porous soil adjacent to a stream channel above the wells to be replenished and high percolation rates. Spreading is done by one of four methods: (1) the basin method, (2) the furrow method, (3) the flooding method and (4) use of pits and shafts. Basin method used where ground surface is irregular and spotted with numerous gullies and ridges. In the furrow method

the water is passed through a series of furrows or ditches somewhat resembling an irrigation project. Used more extensively in stream beds, particularly where, because of flood hazard, no permanent works can be installed. The flooding method is applied where the stream has a wide bottom on which a low dam or weir may be extended. The fourth method is not used extensively because of its high cost and other limitations. Research conducted in '34 on the spreading of off-season runoff of streams flowing from the canyons of the Wasatch Range near Salt Lake City suggests that structural relationships are favorable to the recharging of valley ground water supplies by spreading on the Bonneville sediments.—*H. E. Babbitt.*

**Depletion of Underground Water.** F. T. THWAITES. The Illinois Well Driller 8: 3 (Oct. '38). A classic instance of ground water recession was evident in 1900 in Portage County, Wisconsin, but by '30 the water table had recovered sufficiently to kill trees 30 yrs. old. The level of lakes in the region and the level of the Great Lakes is a close index to the amount of rainfall and the works of man affect the ground water table only to a minor degree. In large bodies of ground water the proportion of shortage to total amount in the ground is so small that the effect on the yield of wells is negligible. It has not been proven that there is a large and progressive permanent fall in the water table due to the work of man although there has certainly been some effect due to deforestation and cultivation. In certain localities where large numbers of wells are in use the withdrawal of water is at a rate greater than can be replenished by underground flow and the water level is progressively falling. Loss of capacity can be remedied in most wells by reaming, shooting, acidizing, cleaning, replacing the screen, or recasing; depending on the circumstances.—*H. E. Babbitt.*

**Necessity of Regulating the Water Well Industry.** ROY S. BARKER. W. W. Eng. 92: 193 (Feb. 15, '39). Well drilling business grown from 1 contractor in '80 to more than 300 at present. Regulation of well industry needed to insure properly designed and drilled wells. Regulation also needed to provide record of drillings and with view to safeguarding interests of society.—*Martin E. Flentje.*

**Wells and Other Underground Works for Water Supplies.** F. R. DINNIS. Surveyor (Br.) 95: 9, 45 (Jan. 6, 13, '39). Most important principles of well location are: (1) adequacy of underground source, (2) closeness to the consumer, and (3) freedom from pollution. The yield of a well is limited by its gathering area, which should be determined, as well as the rate of rainfall and percolation into the ground. Although underground storage is very large it cannot be depended on if the draft exceeds the supply. Surface pollution has been found in wells several miles away, particularly in chalk. In the design of wells, there is a difference between shallow wells, in which the water bearing stratum is exposed at the surface at the site of the well, and deep wells in which the aquifer is overlaid by one or more impermeable strata. Before final design a trial bore and a pumping test should be made at the site. Follow-

ing formulas offer means of arriving at the diameter of a well required to yield a given quantity of water:

$$\text{for shallow wells—} Q = \frac{\pi M h (2H - h)}{2.3 \log \left( \frac{D}{r} \right)}$$

$$\text{for deep wells—} Q = \frac{2\pi M t (H - h)}{2.3 \log \left( \frac{D}{r} \right)}$$

In which  $Q$  is in gallons (Imp.) per 24 hours,  $M$  is the modulus of the material of the water-bearing stratum,  $D$  is the distance from the center of the well to the outer edge of the cone of depression,  $h$  is the infiltration head or drawdown,  $H$  is the total depth of water-bearing stratum,  $r$  is the radius of the well, and  $t$  is thickness of the permeable artesian stratum. The lining or strainer of the well may consist of open-joint masonry or cast-iron segments. Design of lining is a matter of practical requirements coupled with theoretical considerations of a cylinder which has to support the pressure of the subsoil and construction stresses. The bore should be sufficiently large to avoid undue head losses due to friction of the water rising in it. Provision for duplication of well pumps can be made in the case of a large shallow well by putting all of the pumps in one well. In case of wells in fissured rock this may be undesirable and two bore holes should be constructed 50' apart. In the design of an underground gallery water capacity is proportional to length and is independent of width. A height of 4' and width of 2' is quite usual. Yield of an adit depends on its length. It need be large enough only for the passage of men unless to avoid erosive velocities. Subsurface dams are designed to arrest the flow of underground water down a valley. May be simple and inexpensive, consisting of an impermeable wall of clay, concrete, or stonework. Inverted or recharge wells are used to replenish underground water and can be designed on similar principles to ordinary wells. A well which will deliver 1,000 g.p.m. with a 20' drawdown will take 1,000 g.p.m. with a head or cone of 20' above normal ground water surface. Dug wells can be constructed by hand to depths of several hundred feet. Holes can be bored to diameters from 2½" up to 10', and in depths of more than a mile. Main methods of boring in Britain are percussion and rotary. Percussion methods include the cable method and the solid rod. Rotary methods include chilled shot, diamond, auger, and hollow-rod mud-flush. A new method of well construction has resulted from the need of forming a gravel filter or wall outside of the metal strainer.—*H. E. Babbitt.*

**The Underground Waters of Iowa and Their Conservation.** H. GARLAND HERSHEY. *Bull. Assoc. State Eng. Soc.* 13: 4: 101 (Oct. '38). Water well drilling is one of the most important sources of information on the geology of the state. The new geologic map, based on this information, represents the consolidated rocks of Iowa showing what would appear at the surface if there

were no glacial drift. It is used as a basis for forecasts by the Geological Survey for new wells which are being planned. The amount and direction of the dip of the rocks are variable and it is imperative to know as much as possible of the regional and local variations in forecasting the position of important aquifers. Underground sources of water may be classified as: (1) Unconsolidated, chiefly glacial deposits, and (2) Consolidated rocks. The former may again be divided into near surface and deeper glacial deposits. The coolest waters are found in the shallower wells and as the depth is increased the water temperature increases. Conservation of underground waters should be a matter of concern to every resident of the state. A poorly constructed well, even though it is cased, may be virtually an open hole from top to bottom. An extremely bad practice is the drilling of sink holes to get rid of surface waters. Another drain on underground resources has been the increasing use of such waters for air-conditioning purposes.—*H. E. Babbitt.*

**Mineral Analysis of the Underground Waters of Iowa.** Iowa State Planning Board ('38). Report contains mineral analysis and some data regarding 1357 samples of water from Iowa wells. Development of artesian waters for Iowa municipal uses has occurred since '70, by '80 wells totalled 16, by '91 there were 85, and since that time, many more. Iowa is a typically hard water area, many supplies also contain sufficient Fe and Mn to cause difficulty, numerous Fe-removal plants have been built. Most important aquifers in order of importance are: (1) the sandstones—Dakota, St. Peter, Jordan and Dresbach; and (2) the limestones and dolomites. 107 pages of analytical results given, dividing sources by counties; data includes well use, type, depth, static level, chief aquifer, treatment, total solids, alk.,  $R_2O_3$ , Ca, Mg, Fe, Mn, hardness etc.—*Martin E. Flentje.*

**Public Ground Water Supplies in Illinois.** Illinois State Water Survey Supp. No. 1, Bul. No. 21 ('38). Contains data on wells, well yields, material penetrated in drilling, and chemical analyses of water from various sources. Available information is brought up to July, '38.—*H. E. Babbitt.*

**Growth of a Filter Gallery.** DALE L. MAFFITT. W. W. Eng. 91: 1246 (Sep. 14, '38). Des Moines Ia. (pop. 150,000) has since 1871 derived its water supply from underground in glacial deposited sands and gravels in Raccoon River Valley. At present time approx.  $3\frac{1}{2}$  mi. of infiltration galleries in use, about 1300' of gallery along river needed for each 1 m.g.d. At times of low water, flooding resorted to. Chlorine only treatment. Bacterial quality of water good, 37° count always less than 1 per ml. with 200 of 300 top samples showing 0 count. 35,000 meters used in system.—*Martin E. Flentje.*

**Improved Supply Obtained from New Well at Chesley, Ont.** GEORGE GRABB. Can. Engr. 76: 7:6 (Feb. 14, '39). Original supply consisted of 2 wells, 600' deep, with combined capacity of 90,000 g.p.d. Supply was inadequate during peak periods and av. hardness was approx. 675 p.p.m. Studies indicated that water could be obtained from sand and gravel strata overlying limestone in which existing wells had been drilled. New gravel wall well, 8" diam. and

130' deep, was constructed and has supplied av. of 160,000 g.p.d. with hardness of 228 p.p.m. during past yr. Well pump delivers against full main pressure, operation being automatically controlled by level of water in stand-pipe. Time switch limits operation to off-peak load periods. During 24-hr. preliminary test, well produced 235 g.p.m. with drawdown of 55'. Av. drawdown at present is 10' less than when well was placed in service.—*R. E. Thompson.*

**Old Well Replaced in the Savannah Water Supply.** ANON. *Am. City* **54:** 1:59 (Jan. '39). Recent cave-in of old 18" well in Savannah, Ga., would have been prevented if outer casings had been carried to 150' instead of 100'. Water table in old well had been brought down to 68' from surface due to increased demand. However, 30' away a new 613' well, pumping 3,280 g.p.m. against a 150' head, was drilled with 30" casing down 150' and 22" casing to a depth of 270'. Space between limestone and casing was completely sealed. Softer formations were under-reamed to 26" diam. Savannah's 12 m.g.d. are supplied by 9 wells ranging from 500' to 750' deep and 12" to 14" diam. Test well showed no water below 700'. Automatic pump in smallest well maintains pressure at 60 lb. Layne shutter-pipe wells pump direct from limestone rock formation. Emergency reserve of 500,000 gal. and a steam plant able to pump 8 m.g.d., in addition to electric pumps with capacity of 24 m.g.d. are maintained.—*Arthur P. Miller.*

**The Artesian Wells at Memel.** FRIEDRICH MÜLLER. *Gas-u. Wasser*, **82:** 7 (Jan. 7, '39). The public water supply of the city of Memel is from wells about 800' deep into the Devonian Dolomite. The water rises under artesian pressure to about 100' above the surface. This pressure allows free flow from the well to aerators for the removal of hydrogen sulfide. The first three wells of 5.2", 6.5" and 10.5" diam. were placed about 900' apart and influenced each other little in their yield. However, this yield reduced about one third soon after a 10.5" private well was sunk about 1.5 mi. south of the water works. The yield of this private well was originally more than three times that of the total yield of the three wells at the plant, but it diminished with time and dropped temporarily below free flow after attempts were made to regulate the flow by valving. The experiences at Memel show that valving of an artesian well has to be done with great care, especially where the water is under high pressure and the water-carrying strata overlain by clays and marl.—*Max Suter.*

**Tube Wells and Electric Development in India.** J. M. LACEY. *The Engr.* (Br.) **166:** 354 (Nov. 18, '38). Use of tube wells for water supplies in India has grown very rapidly within last ten years. Latest development on a large scale has been in that portion of the Indo-Gangetic plain in the United Provinces. Artesian supplies have been encountered at Lucknow and Agra at various depths down to 1220'. In '54 some 1,300 additional tube wells of 1.3 c.f.s. capac. were constructed in the various western districts of the United Provinces traversed by the Ganges Canal Falls Grid. Practicability of operating these irrigation wells electrically was demonstrated. In the Ganges Valley State-tube-wells Scheme the wells are sunk to av. depth of 250' to 350'

and are fitted with 80' to 100' specially designed strainers, set in the most suitable water-bearing sands, and are pumped with either horizontal or vertical-spindle centrifugal pumps. Life of a well is about 15 to 17 yrs. Although schemes have been developed in Bengal and Bihar, no State-controlled scheme is comparable with that in the United Provinces. Outside of the great Indo-Gangetic plain little is known of the water-bearing capacity of the various formations that are met with in peninsular India.—*H. E. Babbitt.*

**The Use of Domestic Materials in the Construction of Wells.** RUDOLF KRAHL. *Gas-u. Wasser.* **82**: 118 (Feb. 18, '39). Use of wood and porcelain for filters in wells is described. Wood filters are made of hardwood, with vertical slots enlarging toward the interior. Sections are connected by wooden plugs. Porcelain filters have more horizontal slots and a sleeve with a somewhat elastic joint material is used for connecting the different length pieces of the filter. Replacement of the steel casing by non-metallic material gives more difficulty, but a well with porcelain casing is mentioned. Asbestos-cement (Eternit) pipe can be used if protected against aggressive waters. (No details given as to this latter statement which indicates views contrary to U. S. experience with corresponding material.—*Ed.*)—*Max Suter.*

**Explosives in Deep Wells.** E. M. GRIME, C. R. KNOWLES AND G. S. CRITES. *Ry. Eng. & Maint.* **34**: 781 (Dec. '38). The use of explosives can be expected to increase the supply in only certain types of wells and may cause more damage than advantage if not used properly. Such methods should only be handled by experienced men after careful study of the individual situation. Grime suggests use of dry ice as more effective than explosives.—*R. C. Bardwell.*

**Underground Water Supplies.** J. P. LEGRAND. *Surveyor (Br.)* **95**: 379 (Mar. 10, '39). The article presents a generalization of well-known principles and methods of well construction and a non-mathematical discussion of the flow into wells. The elusiveness of the game of hide-and-seek in the search for underground water is illustrated by the rescue by a water diviner of an expensive scheme which was about to be abandoned. It is quite possible for two boreholes only 10' apart to give different results as regards yield. Recommended type of deep well pump is a turbine pump placed at the bottom of the well, driven through a long vertical shaft connected to the motor at the ground surface. Another type of pump which is sometimes employed is known as the ejector pump which may raise water from a depth of 300' by means of water by-passed from the mains. Another type is the pump and motor unit submerged at the bottom of the well. In general, a 12" bore, 500' deep in the London area, will cost about £800. A pumping plant to raise 5,000 gal. (Imp) per hr. from a depth of 300' will cost about £700. *Discussion.* F. C. TEMPLE: During the construction of an open well there should be both sterilization and filtration of the water. PERCY GRIFFITH: Stated that he was a water diviner and could reveal its secrets. Whilst he did not suggest that the water diviner could be completely relied upon there were many occasions when, however complete the geological evidence might be, the water diviner might put them

right on the point. J. P. LE GRAND: Underground contamination might extend two and possibly five miles. A 14-day pumping test is inadequate to determine the capacity of a borehole, although there is no use continuing pumping after the water has reached a constant level. He personally had had some success as a water diviner.—H. E. Babbitt.

**An Inquiry on Water Diviners.** A. LIOUVILLE. *L'Eau* 31: 86 (Aug. '38). Report of an inquiry conducted by the Social Union of Catholic Engineers on water divining and diviners ("Sourciers radiesthésistes"). Modes of occurrence of underground water and available surface signs of its presence are outlined. Representative French geologists and engineers were asked (1) whether they could compare qualitatively results obtained by geologists and non-divining well prospectors with those of diviners, and (2) whether they considered the proportion of success obtained by diviners to be greater than that of other well prospectors. Numerous replies are quoted, and it is concluded that role of divination in art of locating wells is far from being proven. It is difficult to determine to what degree diviners depend on divining and to what extent on their own practical knowledge.—Selma Gottlieb. (See J. A. W. W. A. *News of the Field* 31: adv. p. 1 (Feb. '39)).

### PUMPS AND PUMPING

**Vortex Pumps, or Slip in the Centrifugal Pump.** OWEN A. PRICE. *J. Inst. M. E. (Br.)* 141: 14 (Mar. '39). *Advance synopsis for discussion. Not yet published in full.* The current theoretical treatment of the centrifugal pump is remarkable for its estrangement from the actual performance of pumps; it suggests a reserve of 30 to 50% of pumping capacity available to the designer, although the high efficiency of modern pumps does not support this view. The paper questions the existence of this available margin of capacity and proceeds to examine the energy which rotating bodies of fluid can contain by virtue of their motions. Commencing with the well-known properties of simple forced vortices, the treatment is extended to include radiating currents through the rotating vortices, and expressions are found for the energy which such hypothetical flowing vortices would possess. It is apparent that all flowing vortices must be "hollow" in order to permit of the admission of a continuous supply of fluid at their centers, and the expressions are accordingly adapted to suit. A disparity becomes apparent between pump theory and vortex behavior, but no such discrepancy is found between the performance of a selected centrifugal pump and its corresponding hollow vortex. In order to test this conformity of pump and vortex behavior under widely differing conditions, the author examines a number of test performances from pumps varying considerably in the features of their design. This examination shows limitations to conformity and it appears that the artificial generation of appropriate vortices is beyond the capabilities of certain impellers. It also appears that the pump efficiency suffers when vortex and pump behavior are not in approximate agreement. It is suggested that the transmission of energy to a fluid by a moving vane is possible only when the transmitting capacity exceeds the resistance offered. Under these circumstances, some form of

"slip" can take place between vane and fluid. By analogy with other forms of slip, a "slip ratio" is defined and employed to relate the centrifugal pump theory and the vortex theory, the pump theory representing the capabilities of the vane and the vortex theory the performance of the pump. The value of the slip ratio for good performances is then found to be in reasonable agreement with the slip ratio of other devices operating in fluid. For poorer performances, the examples show a deficiency in the amount of slip and it is suggested that a certain amount of slip is essential for energy transmission. Emphasis is placed upon the importance of studying the physical properties of the moving fluid rather than the potentialities of the actuating vane and it is suggested that the study of hollow vortices and their artificial production offers the key to the understanding of the centrifugal pump, forms a reliable guide for designing purposes, and indicates the scope for research and development.

**Up Goes the Pressure.** H. R. SHERMAN. W. W. Eng. **92**: 242 (Mar. 1, '39). The necessity for having 3 pressure zones in distribution system in the Bronx, N. Y. City, allowed using Catskill high pressure water to drive water turbine and pump to booster system, this pumping Croton water. Station contains 1-15 m.g.d. pumping unit direct connected to water turbine, discharge pressure automatically controlled by regulating inlet water to turbine decreasing and increasing speed. Normal pump speed 850 r.p.m., has been successfully run at 1600 r.p.m. Inlet to turbine 48" main, discharges into 36" main feeding intermediate pressure zone; pump suction 48" connected to low zone, discharges into 48" new pressure zone with pressure of 165'. Saving over electric power operation estimated \$10,000 per yr. Cost per mil. gal. pumped is \$0.82, construction cost \$41,500.—*Martin E. Flentje.*

**Emergency Water Supplies. Stand-by Plants at Pumping Stations.** ANON. Surveyor (Br.) **95**: 362 (Mar. 3, '39). Also **Metropolitan Water Board Portable Generating Sets.** ANON. The Engr. (Br.) **167**: 318 (Mar. 10, '39). In connection with the steps being taken to safeguard London's water supply in case of air raids, orders have been placed for a number of portable generating sets of various kinds to be used as stand-bys in pumping stations. Each set is mounted on a six-wheel trailer. It comprises a 225 hp., 6-cylinder, internal combustion engine driving a 150 kw. d.c. generator, with auxiliaries.—*H. E. Babbitt.*

**The Fareso Rotary Pump.** ANON. Engineering (Br.) **147**: 293 (Mar. 10, '39). The pump is of radial vane type, and has two drums in contact with one another and enclosed in a common casing which has a contour resembling the figure 8. The lower drum has a single radial vane across the space between its periphery and the casing or cylinder. The upper drum is a close fit in the casing and, projecting into the cylinder, forms the division between the suction and delivery sides of the vane. The smallest size of pump weighs 1 lb. and will deliver 21 gal. (Imp.) per hr. at 500 r.p.m. or 85 gal. per hr. at 2,000 r.p.m. The largest size will deliver 120,000 gal. per hr. at 2,000 r.p.m. and weighs 1.5 cwt.—*H. E. Babbitt.*

## DISTRIBUTION MAINS

**New Water Line for Corpus Christi.** ANON. Eng. News-Rec. **122**: 84 (Jan. 19, '39). Increase in pop. from 28,000 to 60,000 in 7 yrs., necessitated increased water supply facilities in Corpus Christi, Tex. Neuces R., on which city built impounding reservoir in '30, provides abundant supply but 20" tar-coated c.i. pipe line laid in '15 had insufficient capacity. Cement-lined c.i. was chosen for new 30" line, 16 mi. long, owing to anticipated relative freedom from loss in carrying capacity with age. Spun pipe was used and lining was screeded into place while pipe sections were rotated. Cutting of lined pipe was effected with lathe-type cutter or by hand with cold chisel and hammer. Wheel-type cutter forms pressure ridge on inner surface of c.i. which tends to shatter and break lining for some distance back. Cement joints selected because of good performance elsewhere and saving compared with lead. Strand of  $\frac{1}{4}$ " braided jute was placed between spigot and bell and dry mixture of cement and water was used for calking, latter being effected in 2 operations, half depth of joint at a time. When leaks were found during line tests, joints were generally cut back half depth of bell over area showing seepage and recalked. Gradual and definite reduction in leakage occurred over period of 2-3 weeks. In Jul. '38, leakage of 1000 gals per mi. per day or 33 gals. per in. per mi. per day was recorded and more recent reports show further decrease.—*R. E. Thompson.* (See also Am. City **54**: 1:46 (Jan. '39)).

**Water Practices of Erie, Pa.** NATHAN N. WOLPERT. W. W. Eng. **91**: 1590 (Dec. 7, '38). Operating practices of Erie, Pa., water Dept. reviewed. J. S. Dunwoody Supt., B. J. Lechner, Secy. of dept. Water sold at flat rate. Copper used for services, leadite joints used with lead for repair of old joints, some new mains laid in parallel to existing main. Hydrants placed 2' from curb; mains 12" and over have valve on hydrant branch; on such branches hydrant outlet nearest valve painted yellow; booster service hydrant top painted white. Schedule of flat rates given, every home inspected yearly. Air conditioning water demands considered no problem. Dept. has interesting shop truck. Stock keeping methods described.—*Martin E. Flentje.*

**Tools and Vehicles for the Maintenance of Distribution Systems.** WALTHER EBNER. Gesundheits-Ing. **62**: 40, 50 (Jan. 21, 28, '39). Importance of the engineer is stressed in coordinating maintenance of distribution. Maintenance and repair crews should be trained to quickly prevent further damage after an accident, to select immediately the best means of repair, and to avoid pollution of non-damaged sections of the system. Their tools should be mobile, fool-proof in arrangement, simple to manipulate and useful even under unfavorable conditions. A car serving universally for all purposes cannot be built. Different types of cars are described and illustrated. Light, fast cars are used for first aid, including closing of valves, traffic regulation, illuminations, determinations of extent of damage, etc. Repair crews use heavier cars, and for larger repairs trailers are used which can be left at the site. Trailers also used for electrical equipment, generators for lights, pumps, electric pipe cutting, or for heavier pumps or pipe repair tools. Also available

are auxiliary, easily demountable pipe lines and special aluminum tanks for distribution of drinking water. Organization of the repair service is described and it is shown that the selection of the men and their training is just as important as that of the mechanical equipment.—*Max Suter.*

**Emergency Repairs to Water Mains.** ANON. *The Engr. (Br.)* **167**: 354. (Mar. 17, '39). Interesting emergency repair methods have been introduced for use where a water main has been destroyed by a bomb explosion; the resulting crater being partly filled with debris. The equipment comprises two gland connectors which are connected to the ends of the broken pipe. These connectors, which have a socket end of sufficient length to cover a fairly uneven pipe end, are fixed to the pipe by set screws around the outside near the gland. A pressure joint is made between the pipe and connector by means of a rubber ring which is expanded by pulling up the nuts on a circular gland plate at the end of the connector. On the connector body are mounted fire hydrants or simple hose connections, the number of which depends on the size of the main. Hoses can be connected for local use or to bridge a gap or pile of debris, and led to similar fittings on the other broken end of the main. (*See also Surveyor (Br.)* **95**: 196 and 452 (Jan. 27 and Mar. 24, '39)).—*H. E. Babbitt.*

**Main Break Detectors.** ALFRED F. THEARD. W. W. and Sew. **86**: 140 (Apr. '39). In order to detect breaks in feeder mains, Pitot tubes were installed in each of the 4 arteries in the New Orleans, La., water system. These were calibrated and connected to indicator charts located in the pumping station. When a sudden change in readings, indicating a break, is observed, the main is cut off promptly.—*H. E. Hudson, Jr.*

**Materials Used for Mains.** (In French.) M. G. LEVI, C. GIORDANI, B. DOMENCO, AND G. MONTI. *Monatsbulletin (Swiss)* **18**: 136 (Jun. '38). *Report presented at Third International Congress of Gas Industry, Paris, June, '37.* ★[Only items of waterworks interest are abstracted.]★ Only cast iron, mild steel, and cement-asbestos are now of much importance, although examples are given of long and satisfactory service from wooden and earthenware mains. C.i. is first dealt with; centrifugal casting, its initial difficulties and how they were overcome; specifications and tests in force in different countries compared; tolerances; joints. Joints receive particular attention with excellent illustrations. Of leaded joints are shown:—the classical type, a modern modification thereof, and the types now favored respectively by city of Berlin, city of Frankfurt a.M., the English (gas) Association, and the American (gas) Association. Improvements notwithstanding, leaded joints have undesirable features and are losing ground to joints with elastic packing: much care and skill must be put into a lead joint to make it sound; it has no elasticity and may gradually work loose under the vibrations of present day street traffic. Seven types of elastic packing joints are illustrated, from the Somzée, one of the earliest, to the Précis-Express of the Pont-à-Mousson, the Gibault (which permits deviation), and the German Halberg, all three representative of latest practice. Flange joints are of many types, one of which is illustrated; they are chiefly of importance at insertions of valves and other

special fittings. *Ibid.* p. 160 (Jul. '38). Steel mains may be welded or seamless, latter preferable. Seamless tube up to 32" now being rolled in Italy; for larger sizes, only welded tube available. Standard specifications not yet agreed upon; but specifications to which materials in use generally conform are given. Welding tests considered of much importance. Joints on steel mains vary so widely in type that one might almost say that on every job of importance the engineer designs a new joint. Good illustrations given of 11 types of butt welds, 13 types of lap welds, and 4 of flange joints. Chief advantages of steel pipe over cast iron include: (1) long lengths; therefore, fewer joints, less costly to lay; (2) leakage practically eliminated; (3) less weight, saving transportation and other costs; (4) elasticity of material, permitting deviation; (5) greater strength to resist emergency stresses. Its chief disadvantage is its greater susceptibility to corrosion, aggravated by its much less wall thickness. Asbestos-cement industry originated in Austria about 1900 and pipe manufacture from this material originated in Italy, about '17. In '35, Italy had 2500 mi. of water mains and 3750 mi. of sewer, besides some gas main, constructed from this material. Process of manufacture described rather fully. The finished tubes are very compact, perfectly round, exact as to size, and very highly polished internally. For sizes below 4" lengths run to 10'; 4" and upwards, to 13'. Wall thicknesses run from  $\frac{1}{16}$ " to  $2\frac{1}{4}$ ", according to size and pressure. Specified pressures run from 5 to 30 atmospheres, never more than 10 atmospheres in the largest (40") size. *Ibid.* p. 184 (Aug. '38). Cement-asbestos is incombustible, un-oxidizable, unaffected by frost, and relatively light, its specific gravity, dry, being 2.0, and after saturation with water, 8% to 10% more. After completion of normal set, further slow maturation sets in, during which it continues to increase in strength, especially if moisture present. It is subject neither to rusting nor tuberculation, nor to attack by stray electric currents. In the form of tubes, its interior polish reduces friction to a minimum and serves to check incrustation and sedimentation. Tubes are light and easily handled and they are cut and shaped with tools used for hardwood. Results given of many tests: In one such series, nine samples of tube, from 4" to 16" and with wall thicknesses from  $\frac{1}{4}$ " to  $1\frac{1}{2}$ ", were tested to destruction and breaking stresses ran from 2130 to 3015 lbs. per sq. in., averaging 2560. In a later series on 4" and 8" tubes of  $\frac{1}{16}$ " and  $\frac{1}{8}$ " wall thicknesses, stresses were found to have reached 4270 lbs. Straight tension tests confirmed these findings. Sample pieces cut from the walls of a tube of large size in a longitudinal and in a tangential direction gave closely agreeing figures averaging, respectively, 2775 lbs. and 3160 lbs. Difference illustrates effect of controlling the direction of the fibers during manufacture. In another series, designed to obtain the elastic properties, a tube was measured 52 times in succession while the internal pressure was varied from 4 atmospheres upwards and then back again, five times, last two maxima being 25 atmospheres: test was discontinued after fifth maximum. Permanent diametral deformation at end of fourth cycle was only 0.00118", while modulus of elasticity was unchanged. *Ibid.* p. 208 (Sep. '38). Results given in detail for several types of physical tests of cement-asbestos tubes of different sizes, including determinations of the modulus of elasticity, and so-called "shock" tests. Conclusions are that cement-asbestos stands up better under stress

than cement; under tensile stress, quite remarkably so. Elastic characteristics appear to be excellent; pronounced pre-ruptural weakness was in no case observed; the regularity and homogeneity of the material appear to be entirely satisfactory. Joints in cement-asbestos pipes fall into two classes, according as the tubes are made with bell or plain ends. Tightness in the bell-end joint is usually secured by a rubber ring driven in before the melted lead, which holds the ring in place. Sometimes, instead of the lead, the spigot end is made with an enlargement at some little distance from the end which serves the same purpose and holds the rubber ring in place. With plain end tubes sleeve joints are required. Of these the lead sleeve and the Gibault metal sleeve seem to be preferred. In both of these, tightness is secured by metal flanges at either end drawn together by bolts. In the lead sleeve joint, the material compressed is the lead and the flanges are shaped to compress the lead into a solid water-tight mass against the pipe walls while they themselves meet together over the lead, protecting it. Once the joint has been made the bolts are removed. In the Gibault joint, rubber rings are inserted at either end between sleeve and flange and pipe wall, roughly triangular in shape, giving perfect tightness when compressed by means of bolts. Other types of sleeve joint are the metal sleeve with melted lead as sole packing, and the cement-asbestos sleeve with which tightness is achieved by two rubber rings, one on each pipe end. All the joints described are capable of adjustment to small deviations. Laying must be carried out with great care and by persons with experience. Where joints to cast iron occur, the greater wall thickness of the asbestos-cement pipe must be provided for. As regards comparative costs of laying mains, in the smaller sizes, cement-asbestos will cost less and in the larger sizes, more, than c. i. At present in Italy, for mains of 100 to 200 mm., the range in most demand, the cement-asbestos tubes are about 20% cheaper to install than c. i.—*Frank Hannan*.

**Jointing of Steel Pipes.** ANON. *Water* (Netherlands) **22**: 53 (Mar. 11, '38). From detailed paper by DR. COLLORIO in *Gas-u. Wasser*. (Ger.) **79**: 47, 48, and 49 ('36). Author believes that tubes welded with water gas and annealed are almost equal to seamless drawn tubes, inasmuch as the weld material retains the elastic properties of the steel. Autogenous, or electric, welding is viewed with much less favor, annealing being generally inadequate; hence material in the weld is lower, not only in strength, but also in elongation. Welding and accompanying phenomena dealt with at length: the various methods of welding, temperature stresses, and form of stress curves. Annealing of trench welds seldom satisfactory, so that subsequent rupture is possible under temperature stress. Importance of sound welds with smooth surfaces urged. As packing materials in bell joints aluminum and soft iron are being tried as substitutes for lead. With aluminum, the filling is not homogeneous throughout. Lead never loses plasticity; not yet known how far this is true of aluminum. Owing to its elasticity, aluminum probably offers more resistance to pinching out under settlement. Both aluminum and soft iron need protection against ground water attack. Soft iron needs much more force to caulk it; compressed air necessary; once in place, it has advantage of great elasticity. While both these new materials technically admissible, their

economy questionable and durability yet to be proved. Cement joints have not gained adoption, but promising results have been obtained with Sinterit, a new material composed of sintered iron mixed with bitumen. The rôle of hemp or jute in rendering the joint water-tight is of great importance. Use of tow soaked in bitumen, or paraffin, is wrong in principle, as capacity for water absorption, upon which tightness of joint depends, is lost. There is, however, no objection to its use as preliminary layer for packing proper. In the long main from the Hartz to Bremen, a thin rubber ring has been inserted before the hemp as aid to tightness; but not found possible to do without the hemp. Tests made in Hamburg on wood wool as substitute for hemp: no unfavorable experiences in 4 yrs. For non-rigid joints, rubber, suitably vulcanized, is chiefly used. Power to vary characteristics in vulcanization is great advantage, different qualities being demanded according to situation. Rubber rings must be made to strict specifications. When light and air are excluded, well-made rubber has practically unlimited life within temperature limits of  $-4^{\circ}\text{F.}$  to  $140^{\circ}\text{F.}$  Types of welded joints discussed in much detail with illustrations. Ordinary butt welds, while they stand up well under axial stress, have so many disadvantages that they are unsuited for important work. They offer but poor resistance to bending stress; they require finishing on the interior surface; centering is difficult, especially with light plate. Various devices (illustrated) to increase resistance to bending stress have been introduced with more or less success. The Irak joint (illustrated) stands out as particularly successful, being so thoroughly reinforced by the long interior nipple that the weld is almost completely relieved from bending stress. Normally executed butt welds exhibit strength from 50% to 70% of that of tube; high-class welds, 60% to 90%; the Irak joint, 90% to 94%, a strikingly high figure. Most welded joints have disadvantage that interior insulation (coating) is burnt off; nor is there in small mains any reliable way of replacing this protection against aggressive waters. For such waters, therefore, welded joints only used on mains at least 20" to 24" diam., through which a boy can creep. Hence development of "brim" welds, in which tube ends are flared in various shapes (illustrated), object being to enable welding to take place at some distance from wall of main thus protecting interior insulation. Illustrations given of various defects in execution of welded joints; also of more complicated welded joints, less limited by tolerances, and able to yield slightly under either axial or bending stress without causing weld to leak. With the "spherical" type, angles up to  $6^{\circ}$  are possible. Bolted joints now only specified for penstocks under medium and high pressures and for large siphons. Even for these uses, welded joint is gaining more acceptance. Riveted joints only used in mains exceeding 24" and with  $\frac{1}{4}$ " to  $1\frac{1}{2}$ " plate. Work must be carefully done. Flanged joints are rigid; too expensive except for special situations. Illustrations of 11 types of flanged joints given. Flanged socket joints much in use; three types illustrated; they allow small degree of mobility. Two examples of screwed socket joints given; suitable for smaller sized mains than preceding. Both screwed and flanged sockets may be designed so as to give (a) complete rigidity, or (b) axial freedom only, or (c) both axial and bending freedom. Of rubber ring joints, the Ross has been used for long time. New Sigur type illustrated, in which rubber ring is 75% of diam. of the main.

Tests on 8" joints of this type disclosed that a rubber ring of 0.625" circular cross-section could, when compressed into an 0.3125" space, withstand pressures of 375 to 485 lbs. per sq. in. dry, and 185 lbs. with water in the pipe, while it can withstand tensile stress of 1765 lbs. Metal ring fitted to prevent blowing out. Four types of sleeve and slip on joints shown. The Simplex is that generally adopted for concrete and cement-asbestos tubes. Dresser and Gibault joints have advantage that tube ends need no machining. The long bolts are disadvantage and joint is troublesome to insulate. Victaulic and Stanton-Wilson joints easily applied but demand exact machining of tube ends. Author then discusses joints from standpoint of rigidity. His preference clearly for rigid joints while admitting certain proportion of mobile joints necessary. He favors assembling main into long lengths, insulating, testing under pressure, etc., before finally lowering into trench: the trench joints can then be made of sleeve type. Welding strongly advocated, but is inadmissible for mains less than 24" if used for soft water, because of insulation difficulty.—*Frank Hannan.*

**Use of Rubber in the Water Industry.** D. J. VAN WYK. *Water* (Netherlands) **22**: 225, 233 (Nov. 18, Dec. 2, '38). Vulcanized rubber is suitable because of (1) low absorption and diffusion in water, (2) mechanical characteristics, such as elasticity, (3) durability, (4) heat resistance. Water absorption is primarily caused by soluble substances and albumen present in rubber and not through the rubber carbohydrates. When rubber is produced by evaporation of latex all albumen and soluble substances are retained. Efforts are made to remove these substances by centrifuging, flotation and heating with ammonia followed by working. The mechanism of water absorption is osmotic in character. From curves presented it appears that water absorption consists of two processes: solution of water in rubber, and formation of salt solutions. The force for water absorption is difference in atmospheric pressure inside and outside the rubber. Experiments show that the absorption is influenced by the content of hygroscopic materials, so that vulcanized rubber obtained by latex evaporation can not be used when it comes in contact with water. There is a relation between absorption and time, but after 2 yrs. equilibrium was not reached, probably on account of oxidation, because when oxygen free water was used equilibrium was established after some time. Temperature affects rate of absorption, rate increasing with increased temperature. With increased hydrostatic pressure rate is very slightly decreased. Rubber with fillers such as chalk, kaolin, barium sulfate and zinc oxide show increased absorption, while carbon has no effect. Soft vulcanized rubber has highest diffusion constant and is best fitted for the water industry. Elasticity should be permanent. Experiments show that good rubber under an accelerated test remains flexible and keeps its spring for a period of one year when stored in air and water. The hardness remained constant. Durability is affected by the type of anti-oxidants added to the rubber and the rate of oxidation or aging. Rubber couplings should be stored at a temperature between 10 and 20°C., relative humidity below 75%, and in darkness. When exposed to 70°C. in air they deteriorate rapidly in 7-14 days. When subjected to 20 kg. per sq. cm. at 60-70°C. stretch and break is increased 75% after 7 days. At 20°C.

and under pressure, stretch decreased after 2 yrs. 36% in air and 24% in water, while break increased 33 and 28% respectively. With accelerators (tetramethylthiuramdisulfide and dipentamethylethiuramdisulfide) stretch, break and heat resistance is materially better. Application to rubber rings and couplings: Simplex couplings with massive rings are deformed 40-50% of the original thickness, but permanently deformed only to extent of 14% after 3 yrs. use. The "Stavely" and "Baxendale" couplings, using massive rings with square cross section, are placed more closed-up and are less deformed. The "Anthony" coupling with wedge formed rings, and the "Victaulic" coupling with U-shaped rings are held in place with clamps, requiring exceptional durability in addition to elasticity. Assaying and specific specifications are necessary, namely: that permanent deformation is less than 5% when pressed to 10-50% of original thickness at 20°C. for 72 hrs.; spring constant at 60 kg. per sq. cm., and stretch 250% before break; water absorption for circular plates of 35 mm. dia. and 5 mm. thickness after 6 hrs. in water at 100°C. not more than 300 mg. per 100 sq. cm.; when gaskets or rings are in layers the bond between textile and rubber, using a strip 25 mm. wide, should be sufficient to withstand pull of 5-6 kg. with velocity of 30 cm. per min.—*Willem Rudolfs*.

**England's Largest All-Welded Pipe Line.** ANON. Civ. Eng. (Br.) **33**: 405 (Nov. '38). Lochaber hydro-electric power development for the British Aluminum Co. There are five steel pipe lines, A, B, C, D, and E. Lines A and B are each 68" and were laid some years ago. Lines C, D, and E are each 78" and recently completed. Each line about 2,900' long. A and B are welded steel with cast-steel specials. The others are welded steel throughout. Individual pipes shop fabricated with max. thickness of  $1\frac{3}{16}$ " and length per section of 30'. Maximum static head is 800 lb. per sq. in. Pipes are spigot and socket type and connected by electric fillet welding the outer and inner joints. After erection all pipes coated with bituminous paint.—*H. E. Babbitt*.

**Welded Joints on Pipe Lines in Practice. The Effect of Temperature Variation.** ANON. Surveyor (Br.) **95**: 173 (Jan. 27, '39). The Liverpool Corporation Water Works is developing the practice of jointing large steel mains by inserting the following spigot in a short sleeve, the joint being formed by two fillets welded in place. A continuous tube is thus formed. No conclusion can yet be drawn from the tests but evidence indicates that it may be desirable to make an allowance for shear resulting from longitudinal temperature stresses. Some provision for longitudinal expansion is essential, probably through flexible joints, as a stuffing box, placed every 1200'.—*H. E. Babbitt*.

**Bell and Spigot Joints with Sulfur Compounds.** MARTIN KOOTZ. Gesundheits-Ing. **62**: 36 (Jan. 21, '39). Old and present day materials are described which contain sulfur as the active ingredient. Three types, Solus, Lavinit and Hermanit are now approved in Germany for use in cast iron sewer lines. Their use, as well as that of Leadite, Lead-hydro-tite and Metallium, in pressure lines requires care, especially where vibration or settlement may occur. Many references to articles on the properties and use of sulfur compounds.—*Max Suter*.

**Sinterite, a New Material for Cast Iron Joints.** HANS VOGT. *Gesundheits-Ing.* 59: 631 (Oct. 24, '36). The use of lead for joints in cast iron pipe has been prohibited in Germany since July 24, '35. First aluminum was the only material used to replace lead, but now Sinterite, an invention of Hans Vogt is also available. Sinterite is made by heating iron powder or iron oxides at temperatures of 1200°C. to 1350°C. in a reducing atmosphere. At this temperature the iron does not melt, but the particles sinter together to form a spongy mass. The material is pressed into small blocks which are held together in rows by small iron wires. The strips so formed are put into the joint over the jute and calked in place similar to lead. A cover of bitumen protects the outside face from corrosion.—P. H. E. A. (See also abstract J. A. W. W. A. 30: 1249 (Jul. '38).)

**Further Tests with New Caulking Materials for Bell and Spigot Joints in Water Pipes.** SIEGFRIED CLODIUS. *Gas-u. Wasser.* 82: 204 (Mar. 25, '39). Results of tests are given on bell and spigot joints of 24" and 32" steel pipes. Aluminum wool (threads 0.045 mm. thick, 0.3 mm. wide), aluminum foil (0.06 mm. thick and 110 to 120 mm. wide) and Sinterite (see preceding abstract) were used as caulking material to replace the lead use of which is prohibited in Germany. The results were compared to those obtained with lead foil (0.4 mm. thick, 70 mm. wide). Each material was tested in each pipe for: (a) Internal pressure necessary to squeeze the caulking material out of the bell while the two pipes were held in position in a press allowing a holding force of 1000 tons. The pressure determined in this way may be called the "squeeze out pressure." (b) Internal pressure to pull the two pipes apart when they are not held with external forces (pipe separating pressure). (c) In each of the above cases the leakage pressure, that is the pressure when the first leakage appears, was also determined. The joints tested were all caulked by an experienced workman of the local water works. Jute was used at the base of the joint. The results suffered partly from experimental difficulties. The material could never be squeezed out even with the highest pressure used (910 lbs. per sq. in.) although some leakage occurred with Sinterite at about 580 lbs. per sq. in. The pipe separating pressures are much lower. For both types of aluminum materials it varies from 80 lbs. in the 32" pipe to 200 lbs. in the 24" pipe. For Sinterite the pressures are even lower, about 50 lbs. in the 32" pipe to 100 lbs. in the 24" pipe. Leakage occurred only after the flange piece was pushed out considerably. From the tests it was considered that the aluminum materials are satisfactory for practical use.—*Max Suter.*

#### SERVICE PIPES

**Concerning Brass Water Pipe and Enforcement of the Plumbing Regulations.** *Health News*, N. H. State Board of Health 16: No. 12 (Dec. '38). A regulation of the N. H. plumbing law stipulates that where brass pipe is used, only red brass shall be installed. As result of consultations with leading mfgs. of brass pipe following conclusions advanced: (1) cheaper yellow brass, 60% Cu and 40% Zn (so called Muntz metal) is grossly unfit for water piping, dezincification and consequent failure tending to be rapid; (2) a better grade with

65-67% Cu has proven disappointing, dezincification is less rapid than with 60% Cu, it does however occur and with corrosive waters metal is rapidly attacked and failures are but matter of short time. This form of yellow brass is wholly unfit for hot water systems; (3) red brass, 85% Cu, is virtually free from dezincifying effect and is only variety that should be used for water; (4) it has been definitely established that red brass (85% Cu) withstands corrosive action better than does straight copper, it appearing that this composition represents the optimum in this respect; (5) with any form of brass, solution of traces of copper occurs, especially in hot water system, with red brass degree of such staining usually is but slight; (6) regulation stipulating use in N. H. of red variety of brass is a reasonable and proper one both from standpoint of insuring durability (although even red brass may be unsuitable for a few waters) and from sanitary viewpoint in that solution of these metals tends to impair potability and general fitness for domestic use.—*Martin E. Flentje.*

**Investigation of Creep and Fracture of Lead and Lead Alloys for Cable Sheathing.** HERBERT F. MOORE, BERNARD B. BETTY, AND CURTIS W. DOLLINS. Bul. No. 306, Eng. Exp. Sta. Univ. of Illinois (Aug. 19, '38). Studies of pressures set up in lead cable sheathing in service have shown that tensile bursting stresses in the vicinity of 200 lb. per sq. in. for short periods of time are quite frequent and that higher stresses, though rare, sometimes occur. This series of tests was performed at stresses of 200 lb. per sq. in. and lower. In tensile creep tests of lead and lead alloys carried to fracture there seems to be three fairly well defined stages: (1) a preliminary stage during which creep starts at a relatively high rate, which diminishes as the stage proceeds, (2) a second stage, during which the creep rate remains nearly constant, and (3) a third stage during which the creep rate increases, the specimen "necks down" and final fracture occurs. The creep rate during the second stage is sometimes taken as the index of creep of the metal. The lower the creep rate the higher the creep resistance. This evaluation, for various tests, is tabulated in the bulletin. A study of the relation of creep to stress indicates that at high stresses the relation  $V = AS^n$  is fairly reliable.  $A$  and  $n$  are experimentally determined constants,  $V$  is the creep rate, and  $S$  is the tensile stress. At low stresses  $n$  has not been found to be constant. The creep resistance of lead and lead alloys diminishes rapidly as temperature increases, and the creep rate increases at a faster rate than does the temperature. The creep of lead and lead alloys under low stresses has been shown to be very sensitive to slight changes of structure which are not readily detected by metallographic analysis nor by short-time (testing-machine) tests. Lead and lead alloys will fracture under long-continued steady tensile load under stresses much lower than those which are necessary to cause fracture in short-time tensile tests. Tests to fracture of specimens of several leads and lead alloys under steady tensile stress suggested the following equation:  $TS = TS' - k(\log T - 1)$  in which  $TS$  is the tensile strength for a given time  $T$ ,  $TS'$  is the tensile stress which will cause fracture in 10 hours, and  $k$  is a constant obtained by tests. Test data and results are given to show the effect of adding a slight vibratory load on the time required to fracture lead and lead alloys already under a relatively

heavy, steady load. Vibratory stress of plus or minus 30 lb. per sq. in. very remarkably shortened the "life" of specimens of lead and lead alloys under steady stresses over a range of 500 to 2,500 lb. per sq. in. Under bending stresses of 10° or more the specimen will fail under a few repetitions of severe stress. Where the angles are less than 45 minutes the specimen will resist many cycles of small flexural stresses. The fatigue strength of lead and lead alloys depends on rate of application of stress, failure being due to a combination of fatigue and creep. A study of progressive expansion (circumferential creep) indicates that the creep rate under internal pressure and the total creep for long periods of time were, in general, less than that in corresponding tensile specimens under one-directional stress. A theory of the mechanism of creep is presented.—*H. E. Babbitt.*

**Service Pipe Materials.** ANON. W. W. Inf. Exch., Canadian Sect. A. W. W. A. 3: C:3:9 (Mar. '39). Tabulation of 85 Canadian municipalities is given showing no. of services, materials used and depth of cover. No. of services of various materials are as follows: copper 31,485, lead 297,910 (132,859 in Toronto), galvanized iron 50,141, wrought iron 4,052, c.i. 4,956, brass 30. Depth of cover varies from 2 to 10'.—*R. E. Thompson.*

**The Determination of the Size of Water Pipes.** H. SCHELLENBERG. Monatsbulletin (Swiss) 18: 196 (Sep. '38) and 18: 258 (Nov. '38). Graphical methods given for detng. proper size of service pipe and building plumbing for various German conditions. Graphical and tabular material given together with calculations for several actual installations.—*Martin E. Flentje.*

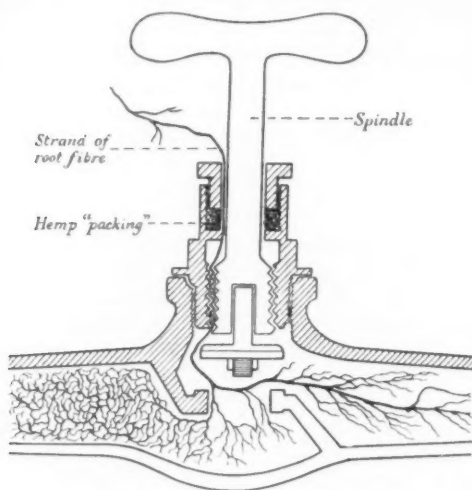
**Lifetime of Service Pipes.** ANON. W. W. Inf. Exch., Canadian Sect. A. W. W. A. 3: C:2:5 (Mar. '39). Tabulation of data on life of service pipes of various materials in 76 Canadian municipalities is given. Life estimates and max. reported period of use, respectively, in yrs., for various materials are as follows: copper, 25-200 and 15; lead, 10+ to 100 and 50; galv. iron, 1-40 and 20; wrought iron, 5-80 and 40; c.i., 20+ to 100 and 62; steel, 5-15 (estimates only); brass, 50 (estimate only).—*R. E. Thompson.*

**Service Installation Costs.** ANON. W. W. Inf. Exch., Canadian Sect. A. W. W. A. 3: B:3:10 (Apr. '39). Details are given of cost per ft. for installing services in 77 Canadian municipalities. Costs are classified under following headings: pipe, excavation and backfilling, assembly, main tapping, overhead and maintenance, total, and additional cost in rock.—*R. E. Thompson.*

**Replacing Service Pipes.** ARTHUR M. FIELD. Eng. News-Rec. 122: 511 (Apr. 13, '39). Deterioration of galvanized services is one of principal causes of distr. system leakage. Cost of replacement may be materially reduced when copper pipe is used as follows: Opening is made at main about 4' along line of service and about 2½' wide and second opening at meter back of curb, just large enough to enable old pipe to be disconnected. Old pipe is disconnected from meter and coil of new copper pipe attached to it with nipple and, after severing from main, pipe pusher in reversed position is used to pull old

service and draw new one into position. In 200 such operations, only once did galv. pipe break during pulling. A  $\frac{3}{4}$ " copper service may be successfully pulled in after  $\frac{1}{2}$ " galv. pipe.—*R. E. Thompson.*

**Water Communication Pipes Under Highways.** ANON. Surveyor (Br.) 96: 377 (Mar. 10, '39). Under the existing law water consumers are responsible for the repair and maintenance of service pipes. In special cases some water utilities had undertaken this responsibility for that portion of the pipe under the street. The object of the bill to be presented in Parliament is to make all purveyors of water financially responsible for this part of the pipe.—*H. E. Babbitt.*



**Root Growth Inside a Tap.** F. HUGHES. Discovery (Br.) 1: 397 (Nov. '38). Reduction in flow led to discovery of root growth illustrated. On inlet side of valve growth was tightly packed for 2"-3". On outlet side there were strands up to 6" long. Fiber was much decomposed and species was uncertain, but possibility of it being beech tree root is assumed. Stuffing box through which root penetrated was tight against pressure of 60 lbs. per sq. in.—*P. S. Wilson.*

#### MINERAL SALTS IN WATER

**The Physiological and Pathological Aspects of Silica.** E. J. KING AND T. H. BELT. Physiological Rev. 18: 329 ('38). An excellent summary—the result of wide reading—of modern knowledge regarding the biological influence exerted by silica is here presented. It is gathered under many headings dealing with the distribution of silicon in nature, the chemical determination of silicon, the presence of silicon in micro-organisms, in plants and in animal tissues, including the blood. Silica may enter the body by either the lungs or the

digestive tract; and may be excreted either by the urine or the bowels. Silica is slightly soluble in water and more so in alkaline solutions, probably in colloidal form. Some substances depress this solubility, particularly alumina. Evidence that silica dust is harmful to man was first revealed by epidemiological investigations of occupational mortality. Research has since been concentrated upon explaining the facts so brought to light. Examination of the morphology of the silicotic nodule in the lungs and of its dust content indicates that the smaller are the dust particles, the greater is the reaction they induce. But doubt exists as to whether silica alone can set up these changes without the assistance of co-existing micro-organisms, of which the tubercle bacillus is the most important. Undoubtedly the presence of such infection hurries on the process, and the inhalation of silica dust will activate a latent infection. Many persons appear to be immune to silica; hence silica *per se* may not be a poisonous substance. Silica and the tubercle bacillus seem to act and react one upon the other to the detriment of the affected host. The old idea that silica dust brought about the well-known changes in the lungs by mechanical irritation has now been quite discarded. Dust and dust alone may produce disability and death; but pure and simple silicosis is seldom of clinical significance. Dust particles appear to be carried by lymphocytes to the nearest lymph nodule where they are caught and slowly pass into solution affecting the neighbouring protoplasm; at the same time micro-organisms tend to be entrained in these same filtering lymph nodules where they come in contact with the modified silicotic material, which seems to be, at any rate for the tubercle bacilli, welcome food. Many investigators hold that pneumoconiotic lesions are really infective from the beginning. But all is not yet known about the pathogenicity of silica.—B. H.

**Chronic Manganese Poisoning with Particulars of a Case.** M. DRAGONETTI. *Rass. Med. Indust. (Ital.)* 9: 94 ('38). There is little literature on the subject of manganese poisoning and some is quite unreliable. For instance, two authors doubt the toxicity of manganese: they say it is found in green vegetables, milk and bones and that as man's blood contains manganese in varying quantities it cannot be poisonous, or at any rate cause chronic poisoning. This view is, however, not generally accepted and manganese is regarded as causing paralysis, difficulty of speech and tremors. It may be inhaled as dust or fumes and causes cellular degeneration in the cerebrum and cerebellum and changes in the lungs, kidneys and alimentary canal. Author emphasizes that there are also blood changes which may prove fatal if not detected. It is, however, the effects on the nervous system which are more commonly observed. The peculiar uncertain walk is described and compared with that seen in Parkinson's disease. Attention usually first drawn to nervous symptoms, but there are others which occur earlier, such as gastro-enteric, hepatic and blood changes which if recognized afford therapeutic opportunities. When once the poison has attacked the nervous system the case is incurable but not fatal. It is therefore necessary that workers should be removed from the risk of further poisoning when any of the early symptoms have been recognized. Author hopes that chronic manganese poisoning will be included as a notifiable industrial disease.—B. H.

**Role of Drinking Water in the Occurrence of Allergic Diseases.** JÓZSEF SÓS AND DEZSŐ KÜNSTLER. *Orvosi Hetilap* **82**: 742 ('38). Allergic diseases (asthma, eczemas, scleroderma, etc.) were found most often in regions where drinking water was low in dissolved salts. Administration of Ca and Mg, especially the latter, seems to be a quick remedy.—C. A.

**Phenol-Contaminated Waters and Their Physiological Action.** V. G. HELLER AND LEE PURSELL. *J. Pharmacol.* **63**: 99 ('38). Rats were given only PhOH solns. to drink. In concns. up to 0.1% no unfavorable action was noted. Reproduction without noticeable interference, through 3 generations, occurred with those given 0.1–0.8% solns. At 1% the offspring died at birth. At this level and at 1.2% young rats grew to maturity but were easily killed by very hot weather. Large amt. of the ingested PhOH is rapidly conjugated and then eliminated in urine but some seems to be metabolized since it could not be accounted for in analyses made. Concns. of less than 1% do not interfere with digestion, assimilation or other metabolic functions. Methods of detg. PhOH in water, etc., are discussed and some modified methods for eliminating interfering substances suggested.—C. A.

**The Occurrence of Arsenic at Reichenstein and the "Reichenstein Disease."** J. KATHE. *Wass. u. Abwass.* **36**: 31 ('38). Chronic arsenic poisoning among the population of the Silesian town of Reichenstein may be traced to pollution of the water supplies by soluble arsenic salts derived from local mines and works. Arsenic, which occurs with gold in the mountains near Reichenstein has been extracted as the main product at these mines since 1700. In 1882, when a shortage of spring water occurred, the use of waters containing considerable amounts of arsenic led to a serious epidemic of arsenic poisoning. Author describes the symptoms of arsenic poisoning caused by water. A water supply system installed in '28 now supplies the district with safe drinking water, the maximum arsenic content of which is 0.015 mg. per liter.—W. P. R.

**The Absorption and Excretion of Lead Arsenate in Man.** LAWRENCE T. FAIRHALL AND PAUL A. NEAL. *U. S. Pub. Hlth. Repts.* **53**: 1231 (Jul. '38). "One hundred mg. of lead arsenate were ingested by two individuals over a period of 10 days while on a controlled diet. The degree of absorption, path of excretion, and toxicity of this dosage were evaluated. Variations of the calcium content of the diet and the effect of change in hydrogen ion concentration as induced by ammonium chloride were noted. While the lead arsenate was completely broken down in the body, no untoward effects on the well-being of these two individuals attributable to this quantity were noted. The greater part of the lead and arsenic derived from the ingested lead arsenate was directly recovered, and it was found that the lead was excreted with the feces and that the arsenic was excreted in the urine."—Ralph E. Noble.

**Studies on the Fate of Selenium in the Organism.** M. I. SMITH, B. B. WESTFALL, AND E. F. STOHLMAN. *U. S. Pub. Hlth. Repts.* **53**: 1199 (Jul. 15, '38). Studies on the fate of Se in the body lead to the following conclusions:

(1) Intravenously injected inorganic Se leaves the blood stream slowly to be selectively absorbed in certain tissues, mostly the liver and kidney, thence to be excreted chiefly thru the kidney. (2) The excretion level of Se in the urine is higher in animals chronically poisoned with inorganic than when similarly poisoned with naturally occurring food Se. (3) Se retention is greater in tissues of animals chronically poisoned with naturally occurring organic Se than with inorganic Se. (4) After a 3- or 4-month poisoning with small doses of inorganic Se, the element is excreted in the urine for about a month. After a similar poisoning period with like doses of naturally occurring organic Se the element is excreted in the urine for 6 mo. or longer. (5) The Se stored in the tissues in the course of chronic poisoning with organic Se is mostly in protein combination. (6) The urinary Se is recoverable quantitatively by simple distillation with bromine-hydrobromic acid-sulfuric acid mixture. Little, if any, urinary Se is in volatile form. Apparently it consists of a relatively stable organic compound or compounds. Little, if any, inorganic Se is demonstrable in animals chronically poisoned with organic Se. In animals acutely poisoned by intravenous injection of inorganic Se up to 50% of urinary Se is recoverable by direct precipitation and is regarded as inorganic. In subacute poisoning with inorganic Se by oral administration some inorganic Se is demonstrable in the urine, but not uniformly.—*Ralph E. Noble.*

**On the Darkening of Aluminum by Hot Water.** J. FISCHER AND W. GELLER. *Z. Metallk.* **30**: 192 ('38); *Phys. Ber.* **19**: 2036 ('38). Formerly accepted view that color produced in aluminum vessels by boiling alkaline water was due to intercrystalline corrosion of the components of the aluminum alloy was proved erroneous. The impression of darkening is given by a slight corrosion of the surface; this theory is confirmed by the fact that darkening begins by formation of an iridescent surface layer. The surface film somewhat increases the resistance of the aluminum to corrosion and has no significance from the point of view of hygiene.—*W. P. R.*

**The Physiological Effects of Small Amounts of Lead: An Evaluation of the Lead Hazard of the Average Individual.** A. S. MINOT. *Physiol. Revs.* **18**: 554 ('38). Review of magnitude of Pb exposure of av. individual and methods of analysis used. There is no doubt that av. individual in modern civilized communities continually ingests or inhales small amts. of Pb. Av. daily incidental exposure is probably 0.2-0.4 mg. Pb, and excretion more or less keeps pace with intake. This intake is considered less than that which is generally found to be dangerous.—*C. A.*

**Lead in Food.** G. W. M. WILLIAMS. Rep. publ. Hlth. med. Subj., No. 88. H. M. Sta. Off., London ('38). Lead may be taken into the system through the lungs from dust, through the skin from cosmetics, etc., and through the alimentary canal from food. Author deals with findings of a number of investigators on the absorption and excretion of lead by the intestinal tract, the content of lead in different parts of the body, and the content of lead in various foods. He points out that in discussing permissible limits for lead in food,

the important point is not whether the limits themselves are safe but what the effects would be on the total intake of lead. There is probably a wide range between the limit for toxicity and a limit for safety below which the harmfulness of lead can be considered negligible. This lower limit of safety is unknown and it is therefore desirable to reduce the content of lead in food to the lowest amount possible. Review is given of a number of methods of determining lead in food and a method which is said to be relatively quick and trustworthy for all foods is described; this depends upon extraction of lead by dithizone and separation as sulfate, with subsequent colorimetric determination as sulfide. Bibliography is given.—*W. P. R.*

**Chronic Lead Poisoning.** HORATIO B. WILLIAMS. *J. Am. Med. Assoc.* **112**: 534 (Feb. 11, '39). A report of chronic lead poisoning due to lead in drinking water, with particular reference to nervous lesions produced. Humans and animals were affected. Water supply was from deep well. Sample directly from well showed no lead. Well water was soft with a pH of 6 and contains considerable  $\text{CO}_2$ . Sample of hot water supply showed presence of 0.18 p.p.m. of lead. Hot water tank was made of a light gage copper. The maker had reinforced the tank at all points where copper had been cut for pipe connections with a liberal coating of wiping solder ( $\frac{3}{4}$  lead), and plumber who installed tank had used a liberal amount of lead paint to make joints tight. The article includes a discussion of neurological pathology and of treatment methods used. A discussion of potential dangers of lead poisoning due to use of lead compounds as insecticides on fruits and vegetables is presented.—*John H. O'Neill.*

**The Solubility of Lead in Drinking Water.** HUGO HAUPT. *Gesundheits-Ing. (Ger.)* **62**: 161 (Mar. 18, '39). Solution of lead starts by action of the dissolved oxygen forming lead hydroxide. In the presence of carbonic acid several types of lead carbonates can be formed. These products and their solubilities are given as follows:  $\text{Pb(OH)}_2$ —85 p.p.m.;  $\text{PbCO}_3 \cdot \text{Pb(OH)}_2$ —0.4 p.p.m.;  $\text{PbCO}_3$ —1.1 p.p.m.;  $\text{Pb(HCO}_3)_2$ —very soluble. Therefore, the more free  $\text{CO}_2$  is in the water, the more are the chances that the higher soluble lead carbonates are formed. Considerable amounts of chlorides, sulfates or nitrates are required to have appreciable influence on the solubility of lead. Hard waters free of aggressive  $\text{CO}_2$  soon form a protective cover of lime and basic carbonate of lead in new lead pipes, whereas soft waters rich in  $\text{CO}_2$  are always aggressively dissolving lead. Protection against lead can be obtained by increasing the hardness to above 125 p.p.m. and eliminating the aggressive  $\text{CO}_2$  by marble or Magno-masse filters. A breakdown in such an installation or the introduction of a new additional supply with lead dissolving properties may suddenly produce dissolved lead in a previously lead free supply. Covering the inside of the lead pipe with lead sulfide or tin has not been fully successful. Wasting the first water in endangered supplies should be considered only as a last resource.—*Max Suter.*

**The "Speed-Up" in Governmental Research.** ANON. *Consumers' Research Bull.* **5**: 7: 24 (Mar. '39). Discusses recent announcement by U. S.

Sec'y. of Agriculture that his Dep't. will now increase the tolerance limit for lead in fruit shipped interstate; tolerance raised from 0.018 grains per lb. of fruit to 0.025 grains. Objection raised to experiments on basis of which tolerance was increased; stated as "Ten milligrams of lead arsenate were ingested daily over a period of 10 days by each of two adult (and no doubt healthy) human subjects . . ." Held that this was far too simple and inconclusive a test.—*Martin E. Flentje.*

**Etiological Study on Endemic Goiter in Jehol. II. Animal Experiments.** SYN'ITI SUZUKI. *J. Oriental Med.* **28**: 881 ('38). All rats and dogs were fed with foods obtained from nongoiter regions, excepting drinking and cooking water. Group A received water contg.  $5\gamma$  I per liter which was obtained from well in goiter region having 34% morbidity; group B's water contained  $14\gamma$  I and was obtained from well from less goiterous region (1.6% morbidity); and group C received water from nongoiter region, contg.  $24\gamma$  I. After 6 mo., av. % I content of dry thyroid of rats of each group was 0.09, 0.33 and 0.46 resp., and that of dogs was 0.09, 0.09 and 0.31; and wt. of dry thyroid of dogs of each group was, in grams, 1.3387, 0.8968 and 0.6650, resp. Iodine deficiency in well water seems to be more responsible than food I deficiency for endemic goiter in Jehol.—*C. A.*

**Relation of the Iodine Contents of Water, Milk and Pasture to the Occurrence of Endemic Goiter in Two Districts of England. II. Medical Survey of the Incidence of Goiter in Somerset and Suffolk.** MATTHEW YOUNG. *Med. Research Council (Brit.), Special Rept. Series, No. 217*: 7 ('36). Survey of incidence of thyroid enlargement among female school children, 6-14 yrs. of age, showed incidence to be high in Somerset and low in Suffolk. Analysis of water in former county revealed marked and consistent deficiency in iodine compared with waters of latter. Milk and pasture samples showed no significant differences.—*R. E. Thompson.*

**The Biological Action of Water Colloids. Experiments with Rice Sprouts.** ST. KONSULOV AND ZH. LAMBREV. *Ann. univ. Sofia, II Faculté phys.-math. Livre 3*, **34**: 477 (In German 481) ('37-8). Further corroborative exptl. proof is given to substantiate hypothesis of K. concerning explanation of causes of goiter. K. assumes that water contains a certain colloidal factor which is indispensable for normal physiol. development of animals. Its lack causes goiter. It is introduced into body by eating meat and drinking water, but not by eating vegetables. Water condensing out of air absorbs this colloidal factor while passing through soil. Distd. water, which does not contain this colloid, causes deficiency in organism and endocrine glandular system. Ultra-filtered water, which cannot contain colloids but contains all the mineral salts, has same physiol. effect on animals and cultures of bacteria as distd. water.—*C. A.*

**Goiter in Hungary and its Relation to the Radio-Activity of the Soil and Drinking Water.** J. STRAUB AND T. TÖRÖK. *Ztschr. f. Hyg. u. Infektionskr.* **121**: 181 ('38). Authors have studied districts in Hungary in some of which

goiter is not seen, in others it is common, as in Vámospéres where the percentage is as high as 22.6. They have estimated the radio-activity of the soil, air and water and the iodine content of the latter in 9 districts. Conclude that the radio-activity of soil or water has no connection with, at least does not explain or account for, the prevalence of goiter, but that there is correspondence between the amount of iodine in the drinking water and the relative freedom from goiter.

PLACE	GOITER	$\gamma$ IODINE	RADIO-ACTIVITY	
			Soil	Water
	<i>per cent</i>			
1	0	21.70	537	0.18
2	0	10.00	25	0.10
3	0	7.50	534	0.61
4	11.7	4.50	115	0.42
5	22.6	5.40	84	0.18
6	40-50	2.60	345	1.69
7	50-60	1.50	152	3.57
8	82.2	0.26	150	0.36
9	83.3	0.68	215	0.09

—B. H.

#### FLUORINE IN WATER

**Mottled Enamel Survey of Bauxite, Ark., 10 Years After a Change in the Common Water Supply.** H. TRENDLEY DEAN, FREDERICK S. MCKAY, AND ELIAS ELVOVE. U. S. Pub. Hlth. Repts. **53**: 1736 (Sep. 30, '38). The production of an unusually severe type of endemic dental fluorosis (mottled enamel) at Bauxite, Ark. (25 mi. SW. of Little Rock; pop. 1800), was halted with change in the common water supply. This is the second recorded instance in the U. S. where a community has abandoned use of an otherwise satisfactory common water supply solely for the purpose of preventing development of permanent dental disfigurements among children. The efforts in each instance were successful. Article includes 3 tables, 2 figures and 12 photographs.—*Ralph E. Noble.*

**Mottled Enamel in South Dakota.** H. TRENDLEY DEAN, ELIAS ELVOVE, AND RICHARD F. POSTON. U. S. Pub. Hlth. Repts. **54**: 212 (Feb. 10, '39). Studies indicate endemic mottled enamel in S. D. seems limited solely to users of artesian water obtained from the Dakota sandstone. Fortunately none of the larger cities in eastern S. D. obtain their common water supplies from this aquifer and the endemicity is limited to the smaller communities and rural districts. Chronic endemic dental fluorosis (mottled enamel) is widely distributed in S. D. The known endemic and "probable" areas with few exceptions are in that part of the state lying east of the Missouri R. There are 41 communities divided among 20 counties where endemic mottled enamel

has been demonstrated by survey. In addition there are 30 other places where mottled enamel is probably endemic. Includes 5 tables and 2 figures.—*Ralph E. Noble.*

**Mottled Enamel in Oklahoma Panhandle and Its Possible Relations to Child Development.** JOHNNY A. BLUE. J. Okla. State Med. Assoc. **31**: 295 ('38). Survey of water supply of Oklahoma panhandle showed wells in endemic area to be 132-330' deep and to contain 0.6-2.6 p.p.m. F. Wells in non-endemic areas contained about 0.6 p.p.m. Shallow wells contained about 1 p.p.m. Studies made on 400 school children: 10% reported fractured bones, 15% rickets, and 43% were more than 10% under wt. Dental caries, gingivitis, and malocclusion rates were much higher than normal.—C. A.

**Endemic Fluorosis and Its Relation to Dental Caries.** H. TRENDLEY DEAN. U. S. Pub. Hlth. Repts. **53**: 1443 (Aug. 19, '38). Examinations of 236 nine-year old children with verified continuity of exposure showed that a higher percentage of children is caries-free in communities where domestic water supplies contain higher fluoride concentrations in comparison with communities using waters of lower concentrations. This limited immunity to dental caries seemed operative with respect to the deciduous teeth as well as the permanent teeth. Analysis of dental caries attack rates in a relatively large number of children in the three States thus far studied (So. Dak., Colo., and Wis.) indicates that the severity of dental caries is, in general, lower in mottled enamel areas as compared with normal areas in the same State. Since the mineral composition of drinking water may have an important bearing on the incidence of dental caries in a community, the possibility of partially controlling dental caries through the domestic water supply warrants thorough epidemiological-chemical study.—*Ralph E. Noble.*

**Effect of Certain Mineral Compounds on the Toxicity of Calcium Fluoride.** A. CHARNOT. Bull. Acad. Med. **120**: 224 ('38). The careful investigations of the French scientists into the somewhat puzzling divergencies in the symptoms of the toxicity due to presence of fluoride in food have produced an explanation. The diversity of the lesions known under the collective title of "darmous" have been analyzed in the ash of experimental animals. These investigations explain the different manifestations reported from time to time as to the variety of the effects of the toxicity of calcium fluoride. The affinity of fluorine for certain simple or compound substances, its prevalence in nature and its association with certain chemical compounds and groups and its cohesion to them seems to point to its biological action being dependent upon these associations. In darmous its association with tribasic phosphate seems to indicate that it plays the part of a mordant. The salts of aluminum when present in food diminish the toxicity of calcium fluoride in natural phosphates and release the phosphates as beneficial elements. The presence of silica on the other hand produces a fragility of the bones. Calcium fluoride associated with these salts manifests itself by modifications in the concentration of different elements found in the ash. The amount of silica is diminished in the absence of salts of aluminum in the food or when free mineral acids are

present in excess, but is augmented by organic acids. Silica fixes fluorine; aluminum diminishes the amount of fixed fluorine except in the presence of silica. The amount of calcium in the ash is increased when calcium fluoride has been added, especially in the presence of phosphoric acid. The result of presence of these elements in food can be tested by radiography as well as by the ash. The toxic effect of calcium fluoride can be detected by X-rays in a generalized hypercalcification more pronounced in the long bones, maxillae, cranium, vertebrae. The toxic effect of the natural phosphates is much the same as that caused by absorption of equivalent quantities of tricalcium phosphate and calcium fluoride. The bones do not increase in thickness but in density as seen by the increased density in the X-rays. In presence of calcium fluoride the salts of aluminum, notably those of mineral acids, diminish the density of bone. When calcium fluoride is present in the food, and other minerals are in excess, various organs are affected in various ways: (1) when mineral acids are present there is sclerosis of the spleen; (2) salts of sodium in excess lead to fatty degeneration of the kidneys; (3) salts of calcium or aluminum (particularly those of the mineral acids) lead to ossified islands in the medullary cavity and a condensation of the bone; (4) silica or silicates lead to ossification and an almost complete obliteration of the medullary canal. These investigations explain the different manifestations reported from time to time as to the variety of the effects of the toxicity of calcium fluoride.—*B. H.*

**Dental Fluorosis and Drinking Water in the United States.** H. T. DEAN. *Bull. Office Internat. d'Hyg. Pub.* 30: 1294 ('38). Trendley Dean, arguing from a wide experience in the United States, suggests that differences noted in Morocco and those reported by him are such as can only be explained by means of quantitative studies carried out on the spot. The symptoms, such as pain on drinking cold water, sensitiveness on eating, have not been noted in the States and he accounts for the severe attrition by the grit which gets into the food, wearing away the enamel and exposing the sensitive part of the tooth. That the water is reported to contain but a minimal amount of fluoride is no criterion for the amount taken into the system, for in such a climate where the heat is intense much larger quantities of water would be imbibed than in other localities.—*W. P. R.*

**Chronic Dental Fluorosis.** ROGELIO A. TRELLES. *Bol. Obras Sanitarias Nacion (Buenos Aires)* 2: 23 (Jan. '38). As a result of the importance assumed by the fluoride problem in Argentina because of the large population affected with mottled enamel, this article was written for the purpose of acquainting doctors, chemists and engineers with the latest information on dental fluorosis published in foreign countries. The cause of mottled enamel, the toxicity of fluorides, the effect of fluoride ingestion on baby teeth, the action of fluorides on animals, the origin of the fluorides present in water, the parts of the world where mottled enamel has been reported, the statistical procedure used for making mottled enamel surveys, the possible causes of error in the surveys, the allowable limit of fluoride concentration in drinking water and the methods for reducing this concentration are reviewed. Attention is called to numerous

cases of "accidental fluorosis," such as those produced by eating fruits and vegetables sprayed with fluoride insecticides, as well as to those resulting from exposure to fluoride-bearing dusts in industrial occupations.—*J. M. Sanchis.*

**Endemic Dental Fluorosis—Amount of Fluoride Allowable in Drinking Water.** ROGELIO A. TRELLES. Bol. Obras Sanitarias Nacion (Buenos Aires) **2**: 367 (Oct. '38). Dental examination of three groups of children residing in areas where the fluoride content of the water was 0.6, 1.2 and 2.4 p.p.m., and who during the first ten years of their lives have made constant use of these waters, indicated following results: Among 2,200 children examined in the 0.6 p.p.m. F zone, not a single case of mottled enamel was found; of 231 children, in the 1.2 p.p.m. F zone, 53% had normal teeth, 16% were doubtful cases and 31% showed slight to moderate mottling of the teeth; 27% of the 180 examinations made in the 2.4 p.p.m. F zone showed freedom from mottling, 25% were classified as doubtful, and 48% were found with moderately severe to severe mottling. No cases of mottled temporary teeth were found in any of the three zones studied. Author is planning to conduct similar studies in other areas to determine effect of variations in mineral content of the water upon the toxicity of fluorides. Experiments with rats are also being carried on concurrently with these field studies in an attempt to obtain a means of forecasting the toxicity of the fluoride content of a water supply by observation of its effect upon the teeth of animals.—*J. M. Sanchis.*

**A Comparison of Sodium Fluoride in the Drinking Water with Similar Levels of Cryolite in the Diet on the Fluorine Content of the Body.** S. MARCOVITCH AND W. W. STANLEY. J. Nutrition. **16**: 173 ('38). Authors studied the fluorine retention in the bodies of rats when fluorine was taken in the drinking water and when the same level was given as synthetic cryolite ( $?AlF_3 \cdot 3NaF$ ) finely divided in the food. The animals were analyzed for fluorine content at birth, at 29 days and at 90 days, the entire body being used (except the stomach and intestines in the 90 day rats). The fluorine content at birth averaged 4.36 parts per million and was the same at 29 days. At the end of 90 days 2.09 p.p.m. were present in the control rats. Those rats given 4 p.p.m. of cryolite in the diet (beginning on the 29th day) showed 7.07 p.p.m. at 90 days. When the same amount of fluorine was given as NaF in the drinking water, a figure of 13.02 p.p.m. of body fluorine was found, that is, the body stores fluorine twice as fast when it is obtained in the drinking water. Striations in the teeth are produced by this amount in water but not by the same amount in food. Female rats showed a significantly greater proportion of fluorine in their bodies than did males when given fluorine additions to the diet or drink.—*B. H.*

**Darmous: Effect of Phosphatic Soil in Chronic Fluorosis.** GAUD AND A. CHARNOT. Bull. Office Internat. d'Hyg. Pub. **30**: 1280 ('38). Authors recount experiments of Velu on sheep affected by this disease known by natives in North Africa as "darmous." This is not altogether comparable to condition described in this country and above all in the United States as Mottled

Teeth which, it has been proved, is occasioned by excess of fluorides in the water supply. Velu found that he could produce this condition in sheep by giving them water to drink which contained natural phosphates and he was puzzled by the observation that animals in one district were exempt from the darmous while those drinking the water in another place were affected. Gaud and Charnot examined these reports and made some experiments, with same result. They were perplexed by finding that the amount of fluoride in the water was not an appreciable percentage and they came to conclusion that the severity of the lesions must be due to the vegetation which grew on the affected soil. They also concluded that the phosphatic soil was deeper in some areas than others and that where the surface was hard and dense the herbage was not affected, but that when the surface was thin and light the wind blew the dust on to the leaves and in this way the animals became intoxicated more from the dust than from the water. Intoxication periods are intermittent, disappearing during the rainy and reappearing during the dry seasons.—W. P. R.

## NEWS OF THE FIELD

How long, Mr. John Q. Public? How long, Mr. Mayor? How long will the people of the United States, who depend for life and health upon their public water supply, allow items such as this to be a part of our municipal record:

"Municipal Council on Thursday night appointed ——— superintendent of water works. Mr. ——— studied at the ——— Street High School and has operated a filling station at ——— and ——— streets for the past several years. Mr. ———'s father was a county commissioner and Mr. ——— has been a life-long Republican. Mrs. ——— [the new water superintendent's wife] was a leader in the Blank-for-Mayor Club."

Naturally the names of individuals, streets and the town are omitted—primarily because the circumstances are not unusual and nothing would be gained by such reference as would make it appear that the particular community's political sanitation was of unusually low grade.

What a list of qualifications—a filling station proprietor, a native son, a life-long Republican, a father who was a county commissioner, a wife who was a leader in the Blank-for-Mayor Club. If one studies that reference list for hours, the only item of hope it holds is the idea that a filling station proprietor at least may be conscious of what a meter means to his business and as water works superintendent be mindful of what water waste can do to the department's balance sheet.

But if one reads the qualification list till Doomsday, beyond that faint hope of meter consciousness, nothing appears that would recommend the man any more for the position of water works superintendent than for that of dog catcher.

No, this is not unusual. A clipping from a newspaper of a nearby city records another superintendent's appointment. Is he an engineer? No! No! Is he a trained man? No! No! Is he anything else that really fits him to be water works superintendent? No! No! But he got the job—because he is Republican County Chairman.

These men deserve to be immortalized along with that marvelously capable superintendent in an Indiana town who naïvely admitted that he paid no attention to the reports of the State Board of Health because he could not read.

This Association can do its utmost to improve the character of water supply service. It may gather in its Journal the record of progress in engineering and sanitation. But apparently it must keep everlastingly at the job of making the people understand that it takes something different

*(Continued on page 2)*

(Continued from page 1)

from political activity to make a man capable of carrying on public administrative service.

More than anything this association can do, it is the responsibility of those men and women who bind themselves together in "Civic Clubs" and "Citizen's Leagues" to fight for the type of improvement in municipal political hygiene that the engineers have fought to win in water supply quality.

Deaths from water-borne typhoid and loss of jobs by capable water works superintendents are both the result of filth diseases, the one due to environmental dirtiness and the other the product of a political miasma.

Women's clubs and Leagues of Women Voters have a marvelous opportunity for useful public service these days. The field of public administration of technical services has been greatly widened. But the political disease rate is still high and just as disgraceful as was the urban typhoid death rate of thirty years ago. Typhoid, cholera, yellow fever and the like are now held in check, not destroyed. Constant control of the now known sources of diseases keeps them in check.

How long then, Mr. John Q. Public, will it take you to learn that the spoils system in control of municipal public services is a disease that should be held in check just as is cholera and that you—Mr. Citizen—are the only person who can do the job of cleaning up.

**The adjustable salary scale** in use for the city employees of St. Paul, Minn. is described in an abstract on page 139 of this issue. This adjustment is a percentage adjustment on the basis of costs of living and is independent of any other individual adjustments based upon merit, performance, service or other factors. The system has a creditable record of successful performance.

Our abstractor in this case, M. N. Baker, who has long had contact with municipal administrative problems, fails to recall any other case of a systematic living-cost basis for salary adjustment and wishes to query Journal readers as to the existence of any similar plan elsewhere.

**A new type of reflector** has been developed for installation on fire hydrants in order to increase their visibility at night. It is known as the "Flector Light" and is the invention of L. R. Blackman of Bridgeport, Conn.

**Threat of a water famine** was averted in St. Louis, Mo. on December 13, by resumption of pumping at three large stations after the city's

(Continued on page 4)

# *Nothing takes the place of the* **LEVER**

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**T**HE LEVER and fulcrum as an engineering principle—cast iron pipe as a long-lived material for underground mains—nothing has taken their place for centuries. Yet both have been highly developed in design and efficiency.

If you demand *proved* long life and low maintenance cost that result from effective resistance to corrosion—assured safety margins for impact, beam load and crushing stresses—and permanently tight joints—then you will agree that *nothing takes the place of cast iron pipe*. Some materials meet some of these requirements but only cast iron pipe meets them all.

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# **CAST IRON PIPE**

*The Standard Material*  *for Underground Mains*

(Continued from page 2)

four plants had been closed during the previous night by a strike of over a hundred engineers and apprentices, members of the International Union of Operating Engineers. It is said that the engineer's union (a division of A.F.L.) has been involved in a factional dispute with the Stationary Firemen, Oilers, and Coal Passers Union, and that wages and hours were not an issue.

The largest city plant, the Bissell Point Station, was opened under the supervision of John B. Dean, Water Commissioner. Twenty-five police marshalled a group of non-strikers, members of the Stationary Firemen's Union, and led them into the Bissell plant, operation of which, with the reserve of water, was sufficient to prevent a water shortage.

**Alfred Theard**, General Superintendent of the New Orleans Water and Sewerage Board, died on January 2 at his home in New Orleans.

He was a native of New Orleans and became connected with the office of the City Engineer in 1893. At that time he participated in the completion of a topographic survey which became the basis of the present drainage system of the city. In 1896 he became office engineer of the old drainage

(Continued on page 6)

**W. P. A. to Stop Heavy Leaks in Water Mains**

Somervell to Check Loss of 20,000,000 Gallons a Day: All Underground Systems To Be Mapped

Efforts to prevent 20,000,000

Where Tegul-MINERALEAD is properly used for jointing bell and spigot main, there are no leaks. The unavoidable initial leakage stops almost at once • Backfilling of trenches can proceed immediately, doing away with traffic hazards • The ingot form can be stored in the open—rain, snow and flood won't harm it

—and it is easy to handle and ship • Properly mixed at factory, it cannot change en route to you • May we tell you how Tegul-MINERALEAD saves money, time and trouble • Write The ATLAS MINERAL Products Company of Pa., Mertztown, Penna.



**Tegul-**

**MINERALEAD**

OVER 500 municipalities use American or New York Continental Jewell Water purification equipment.

**WATER FILTERS  
WATER SOFTENERS**

Proportionate Electro-Magnetic Chemical feeders for feeding lime, acid, alum, soda ash. etc.

**AMERICAN WATER  
SOFTENER COMPANY**

Lehigh Avenue and 4th St.  
Philadelphia, Pa.

TELEPHONE 361

**LEBANON WATER WORKS**  
OFFICE IN CITY BUILDING

LEBANON, INDIANA.

111 E. MAIN STREET

March 25, 1937

The Mathieson Alkali Works, Inc.  
60 East 42 Street  
New York City, N. Y.

Gentlemen:

Our satisfaction with your products is based on our experience with your HTH and Chlorine.

We use HTH for sterilizing mains, extensions and services in all installations. In services and small pipe extensions, we use a teaspoonful of HTH per joint of pipe or per service and allow to stand 24 hours, then flush it out. We follow the same procedure for mains using larger quantities of HTH, and in both cases we test our water for gas formers before cutting into service. We use HTH around our water plant where sterilizing needs to be done, also after our storage reservoirs are cleaned we sprinkle HTH on the floors.

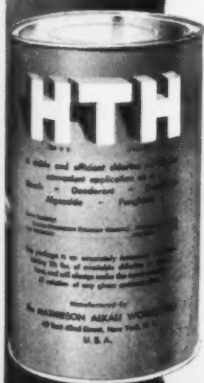
At our sewage treatment plant we use Mathieson chlorine for pre-chlorination of sewage ahead of the primary clarifiers, also ahead of our filters and secondary clarifier. We use the chlorine for odor control, pooling of filter beds and the formation of ferrous chloride going into our secondary clarifier.

HTH in our opinion is an excellent source of chlorine for a sterilizing agent and it is very convenient.

We have never experienced any sticky cylinder valves or dirty cylinders with your chlorine and we are glad to say a good word for your prompt service and personnel.

Very truly yours

*Thos. J. Burrin* Supt.  
Thos. J. Burrin



**FROM LEBANON, INDIANA**  
COMES FURTHER EVIDENCE THAT WATER WORKS MEN APPRECIATE  
**HTH AND MATHIESON CHLORINE**

(Continued from page 4)

commission and in 1902 he was named first assistant engineer of the Water and Sewerage Board. He was made general superintendent in 1935.

He will be remembered well by the A. W. W. A. members who were fortunate guests of New Orleans at the 1938 Convention as a gracious and courteous gentleman who took great pride in the department under his control and who served his community with quiet devotion.

**A. Baldwin Wood**, since 1899 a member of the staff of the New Orleans Water and Sewerage Board and since 1920 its chief mechanical engineer, was appointed, on January 4, 1939, general superintendent of the department to succeed Alfred Theard, deceased.

Mr. Wood is internationally known for designing the special pumps used in New Orleans drainage pumping stations and copied in similar installations in many places over the world. He is a native of New Orleans and a graduate of Tulane University.

The **Engineer School Library**, Fort Belvoir, Virginia, has just completed the publication of a supplement to *Dams*, A Bibliography of Books,

(Continued on page 8)



An electrical appliance which eliminates Rusting, Corrosion, Pitting and Painting below the water line in Steel Water Tanks.

Costs about as much as a coat of paint to own, and less than 50¢ a month to operate.

Send for Bulletin 55,  
A fine explanation of Rusting

**RUSTA RESTOR CORPORATION**  
FREMONT, OHIO

It makes NO difference to



"Perchloron"  
"HTH"  
"Columbia"  
"Wil-Chlor"  
"Maxochlor"  
"Purex"  
"Chlorofectant"  
"Chlorox"  
"Isco"  
"Kohnstamm"  
"Clor-O-Mor"

Accurately fed by **Chlor-O-Feeders**, these chemicals have all been proved practical in chlorinating medium and small water and sewage plants; and even to sterilize big plants in emergencies.

**% PROPORTIONEERS, Inc. %**  
18 Codding St., Providence, R.I.



# **WORTHINGTON EQUIPMENT FOR WATER SUPPLY**

**CENTRIFUGAL PUMPS**

**STEAM AND POWER PUMPS**

**DEEP WELL TURBINE PUMPS**

**SUMP AND DRAINAGE PUMPS**

**DIESEL ENGINES**

**GAS ENGINES**

**STEAM CONDENSERS**

**CONDENSER AUXILIARIES**

**FEEDWATER HEATERS**

**STEAM-JET EJECTORS**

**STATIONARY AIR COMPRESSORS**

**PORTABLE AIR COMPRESSORS**

**ROCK DRILLING EQUIPMENT**

**CONSTRUCTION AIR TOOLS**

**V-BELT DRIVES**

**AIR LIFTS**

**STEAM TURBINES**

**REDUCING AND INCREASING GEARS**



## **WATER METERS**

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

**WORTHINGTON PUMP AND MACHINERY CORPORATION  
WORTHINGTON-GAMON METER COMPANY**

General Offices: **HARRISON, NEW JERSEY** District Offices and Representatives in Principal Cities

(Continued from page 6)

Periodicals, and Society Publications, appearing from January 1924 through March 1936, compiled by Alvan W. Clark, Librarian. This Supplement of 110 pages brings the bibliography up to date (approximately November 1, 1938). It is in loose-leaf form, with the same arrangement as the original edition. Although most of the publication is in the nature of a supplement, certain pages are planned for insertion in place of specified pages in the original, where the topics have been considerably expanded in the past two years. Although a price of 50 cents has been tentatively set on this supplement, all purchasers of the original bibliography are to be supplied with copies free of charge from The Engineer School, Fort Belvoir, Virginia.

An electric sterilizer for swimming pools has been developed by the Everson Manufacturing Co., Chicago. According to a recent bulletin, the sterilizer produces sodium hypochlorite electrically from ordinary rock salt and water, at the same time fulfilling completely all municipal, state, and federal health requirements.

Sodium hypochlorite ( $\text{NaOCl}$ ), popularized during the World War

(Continued on page 10)

## WHITE FILTER SAND

98% Pure Silica



Washed, Screened and Dried.  
No Freight on Moisture—  
Prompt shipment in Bags or  
paper lined Box Cars—Write  
or wire us for information and  
prices.

DAWES SILICA MINING  
COMPANY  
*Silica Mines*  
THOMASVILLE, GEORGIA

## EDSON DIAPHRAGM PUMPS

Hand Operated—size 2", 2½", 3", 4"

Power Operated—size 3" and 4"

Open Discharge or Force Pump  
Skid, Truck or Trailer Mounted

Complete Pump Outfits, Genuine  
Edson Pumps, Suction Hose,  
Brass Couplings, Bronze Clamps,  
Red Seal Diaphragms,  
Brass Strainer or Foot Valve,  
Hose Spanners, Adapters, Etc.  
Standard Hydrant Protector,  
Brass Hydrant Pump.

### THE EDSON CORPORATION

Main Office and Works: 49 D St.,  
South Boston, Mass.

New York: 142 Ashland Pl., Brooklyn

# THE ANSWER TO A PROBLEM

# ALCO PIPE

FOR

**C  
H  
I  
C  
A  
G  
O**

Cities using  
ALCO STEEL PIPE  
include the  
following:

Auburn, N. Y.  
Birmingham, Ala.  
Buffalo, N. Y.  
Chicago, Ill.  
Cincinnati, Ohio  
Clarkburg, W. Va.  
Cleveland, Ohio  
Denver, Colo.  
Detroit, Mich.  
Fairport, Ohio  
Fort Wayne, Ind.  
Elizabeth, N. J.  
Hartford, Conn.  
Manitowoc, Wis.  
New York, N. Y.  
Niagara Falls, N. Y.  
New Brunswick, N. J.  
Ogden, Utah  
Philadelphia, Pa.  
Salamanca, N. Y.  
Washington, D. C.  
Wilmette, Ill.



The Water Department of Chicago and the Chicago Union Station were jointly and seriously concerned about the material to use in the 36" line to replace pipe running under the tracks of the station. The answer, illustrated above, is Alco Electric Welded Steel Pipe. No further need to worry about disastrous breaks.

## ALCO FEATURES

Greater Strength  
Longer Life  
Smoother Waterway  
Longer Lengths  
Fewer Field Joints  
Low Initial Cost  
Ultimate Economy

Alco Electric Welded Steel Pipe is supplied in diameters from 18" to 120"

## ALCO PRODUCTS DIVISION

30 Church Street

New York, N. Y.

CHICAGO

WASHINGTON

PITTSBURGH

HOUSTON

TULSA

Plants at Dunkirk, N. Y., and Montreal, Canada

Cable Address: Alproducts.

**AMERICAN LOCOMOTIVE COMPANY**



## *But Valueless for Water Purification*

Although the diamond is carbon in its most valuable form, it is worthless compared to **CLIFFCHAR ACTIVATED CARBON** for water purification.

Leading municipalities place high value on **CLIFFCHAR** to remove objectionable taste and odors from water supply.

### **CLIFFCHAR "R"**

#### **Special Grade for Water Purification**

Low phenol value, shown by standard phenol tests, gives high ability to remove phenolic and similar compounds.



REG. U. S. PAT. OFF.

Extreme fineness (99% passing a 325 mesh screen) gives maximum surface exposure and adsorptive capacity.

Controlled, uniform density assures sufficient suspension period to take full advantage of its high adsorptive ability, yet settle out in ordinary settling basins.

The technical and laboratory facilities of this company are available without obligation to those concerned with taste and odor problems in water purification. Your inquiry is invited.

**CLIFFS DOW CHEMICAL COMPANY, Marquette, Michigan**

*Branch Sales Offices: 30 Rockefeller Plaza, New York City; Second and Madison Sts., St. Louis; Field Bldg., Chicago*

*(Continued from page 8)*

as a surgical disinfectant, is now widely used in the home under many trade names, such as "Zonite," "Chlorox," etc. While deadly to germs, this disinfectant has the unique characteristic of not irritating human skin and membranes. Even with a relatively high dosage of sodium hypochlorite, water is said to be neither noxious nor irritating. Because it retains its germicidal powers over a long period of time, it is still active when fed through filters by a pool's recirculating system, and it sterilizes and cleanses as it goes by.

Advantages claimed for this method are the elimination of the storing and handling of chlorine gas, avoidance of vented vaults and other regulations, use of a relatively untrained operator, and economy of operation on 10 or 15 cents per day.

**For high pressure service**, single suction multistage pumps have been developed by the De Laval Steam Turbine Co., Trenton, N. J. A recent catalog describes the use of a disk which is subject to discharge pressure upon one side and to an automatically controlled reduced pressure upon the other, and which has a close axial clearance, but no contact, with the cas-

*(Continued on page 12)*



## P.D.M. MUNICIPAL HEADQUARTERS for ELEVATED TANKS

P-D-M Elevated Steel Tanks are supplied in all sizes, from 5,000 gals. to 5,000,000 gals. capacity.

P-D-M Products for the American Municipality include: Elevated Steel Tanks . . . Steel Reservoirs . . . Water Refusing Plants . . . Steel Incinerators . . . Swimming Pools . . . Steel Grandstands. Bulletins gladly sent on request.



● Pittsburgh-Des Moines' high place in the regard of the many municipalities who have invested in P-D-M Elevated Steel Tanks is maintained by the sterling performance and lifetime durability of these famous products. The thousands of P-D-M Tanks serving villages, towns and cities throughout America prove to everyone's satisfaction that P-D-M's "know how" is unsurpassed in modern tank design, fabrication and erection.

If improvement is desirable in your own community's water service, it will cost not a whit to have a skilled Pittsburgh-Des Moines Engineer make a preliminary survey of the problem. His broad experience has been gained in dealing with similar needs in like communities—and he will be glad to detail to you and other interested local authorities how P-D-M Elevated Water Storage assures continuous water supply at uniform pressures throughout the day and year . . . how it lowers operating costs, and *better* service for every consumer.

Let us arrange a consultation for you—and meanwhile, send you our informative 20-page bulletin on "Modern Water Storage in Elevated Steel Tanks." No obligation, of course!

## PITTSBURGH • DES MOINES STEEL CO.

PITTSBURGH, PA. 3424 NEVILLE ISLAND—DES MOINES, IOWA. 925 TUTTLE STREET

New York, Room 921-99, 270 Broadway . . . Chicago, 1228 First National Bank Building

Dallas, 1229 Praetorian Building . . . San Francisco, 631 Rialto Building

**NOW PROVED TO BE—**

**. . . . "worth the difference"**

- (1) STANDARD ACTIVATED ALUM
- (2) ACTIVATED BLACK ALUM
- (3) COPPER ALUM

*Developers of the new "High Alumina" activated alums*

## Activated Alum Corp.

CURTIS BAY

BALTIMORE, MARYLAND

*(Continued from page 10)*

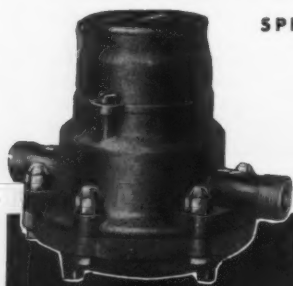
ing. Thus, advantages are claimed over the drum type of balancer. Other points cited in the catalog are: the use of labyrinth wearing rings to reduce leakage from discharge to suction; the design of a horizontally split casing to make interior parts more accessible; and the use of solid, one-piece diaphragms between stages.

Dr. Edward R. Weidlein, Director, Mellon Institute, Pittsburgh, has announced the establishment of an Industrial Fellowship in that institution by the United States Gypsum Co., of Chicago, Ill. This Fellowship will conduct fundamental research on various products manufactured by the donor company, with the objective of developing new processes and technics which will have broad application in the field of building materials. This investigation will augment the regular research activities carried on by the donor.

W. W. Hurlbut, A. W. W. A President in 1936, was, on January 12, named Assistant Chief Engineer and General Manager of the Los Angeles Water Department. The appointment places Mr. Hurlbut automatically

*(Continued on page 13)*

## FIRST QUALITY METERS EXCLUSIVELY



SPECIFY

*American or Niagara*  
(BRONZE CASE) (IRON CASE)

*Water Meters*

WRITE FOR CATALOG

**BUFFALO METER COMPANY**

Established 1892

2914 Main St., Buffalo, N. Y.

New York  
Boston  
St. Louis  
Detroit  
Pittsburgh  
St. Paul

(Continued from page 12)

in charge of the department whenever H. A. Van Norman, Chief Engineer and General Manager, is absent from the city. Hurlbut has been with the Los Angeles department since 1907. Since 1928 he has been Engineer in charge of construction, operation and maintenance of the entire water system within the city.

Open house was held by Crane Co. at its Chicago Works last fall to celebrate an expansion of its research and engineering program. Crane Co. now counts its research personnel at 285 persons who range from experts in metallurgy to specialists in ceramics.

Research in metallurgy is probably the largest single activity in the company's laboratories. Equipment for research includes a miniature foundry with two high frequency induction furnaces, one a tilting type and the other a lift coil type. Optical apparatus for examination of metals includes a metallographic microscope which will magnify to 6,500 diameters, a universal microscope for metallographic and petrographic work, an optical dilatometer for study of the action of metals under heat, and equipment for studying creep and for measuring hardness of metals.

There is also a special machine for measuring the wear and seizure of

(Continued on page 14)



## The Last Word

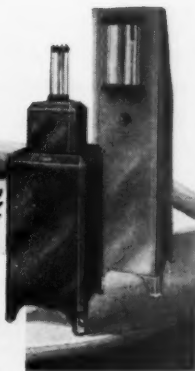
in chlorinating and ammoniating equipment is the new automatically safe

### SterElators by EVERSON

Automatically Safe, Vacuum Operated SterElators, the most advanced of a long line of EVERSON Sterilizing equipment. Especially recommended for sewage and city water treatment.

- AUTOMATIC WATER SHUT OFF
- AUTOMATIC GAS SHUT OFF
- AUTOMATIC SYNCHRONIZATION WITH PUMP
- SINGLE VALVE OPERATION
- VISIBLE ROTA METER (accurate to plus or minus 1%)
- OPERATES UNDER 20" Water Gauge Vacuum
- FAR WIDER METERING RANGE IN ANY CAPACITY  
Standard Ratio 1-10

MULTIPLEX—Multiple feed to two or more points from one SterElator, with quantity to each point individually controlled and metered—Virtually two machines for a fraction above the cost of one.



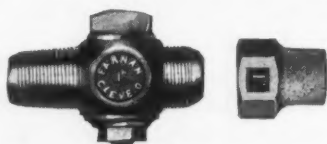
Write for Water Works and  
Sewage Bulletin No. 1004  
**EVERSON MFG. CO.**  
221 W. HURON ST., CHICAGO, U. S. A.

New York  
Boston  
St. Louis  
Detroit  
Pittsburgh  
St. Paul

BRANCHES  
Dallas  
Houston  
Okla. City  
Nashville  
Miami  
Dayton

Amarilla  
Wichita  
San Antonio  
Moline  
Missoula  
Worthington

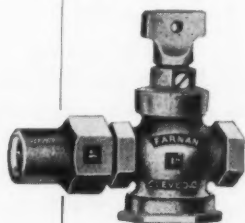
# FOR DEPENDABLE QUALITY SPECIFY FARNAN



No. W-100

Our complete line consists of Corporation Stops, Curb Stops, Couplings and Fittings for copper, iron and lead pipe services . . . all thoroughly tested with 200 lbs. hydrostatic pressure.

We have had 86 years of manufacturing experience.



No. W-1800

**FARNAN BRASS WORKS CO.**  
**CLEVELAND** ESTABLISHED 1852 **OHIO**

(Continued from page 13)

metals under conditions to which gate valves are subjected. Also in the laboratory is a 400,000-volt X-ray which enables research workers to examine metals to a maximum depth of ten inches although for practical purposes five inches is about as far as the instrument will penetrate.

**Obnoxious Whang in City Water Supply Explained**—this is the heading under which the New Lexington, Ohio, *News* brings information to the layman. The newspaper says, "At last the explanation as to the bad taste which annually taints the water of New Lexington has been learned."

"The obnoxious whang which curls the palate and must cause quite a churning in the abdomen is caused by the water in the city reservoir turning over. To the laity it must sound very foolish for water in a reservoir to turn over but such is the case. The explanation is that each year as fall approaches the water on the surface of the water is warm but the air is colder."

**Sixty-nine feet below** the water level of the Buffalo river, directly across from the triangular intersection of Louisiana and Ohio streets in Buffalo, New York, WPA workers are reconstructing two shafts and a tun-

(Continued on page 16)

## ADVERTISING RATES

Journal of the  
AMERICAN WATER WORKS ASSOCIATION

22 EAST 40th STREET

NEW YORK, N. Y.

## 1. GENERAL ADVERTISING

(a)	1 Month (per issue)	3 Months (per issue)	6 Months (per issue)	12 Months (per issue)
1 page	\$80.00	\$65.00	\$55.00	\$50.00
$\frac{1}{2}$ page	50.00	40.00	35.00	31.00
$\frac{1}{4}$ page	35.00	25.00	20.00	18.00
$\frac{1}{8}$ page	18.00	14.00	11.00	9.00
1/12 page—Professional Card (under special classification only).....				
				\$3.00

(b, c) No time or space discounts.

(d) Covers and special positions—Yearly basis.

(e) Outside front—no advertising.

Inside back..... \$60.00

Other special positions..... 60.00

Inside front..... 65.00

Outside back..... 90.00

(e) Minimum size of advertisement is  $\frac{1}{8}$  page— $2\frac{1}{8}$ " long x  $1\frac{3}{4}$ " deep (except Professional Card—

1/12 page under special classification).

(f) Space to be used within one year from date of contract.

Color and insert rates on application.

2. CLASSIFICATIONS—(a, b)—None. (c, d)—Professional Card—1/12 page. Limited to advertisement of professional services. Further information upon request.

## DEFLUORITE PURIFIERS

Remove Fluorine from Water — Prevent Mottled Teeth

**F**LUORINE in a water supply, causing unsightly mottling of teeth, now can be removed effectively and economically with Defluorite Purifiers.

**Many Advantages**

In addition to the high efficiency of the fluorine adsorbent, Defluorite Purifiers offer a new method of regeneration. This greatly prolongs the active life of the adsorbent and makes possible the use of ordinary materials of construction. Efficiency is thus further improved and both initial and operating expenses lowered.



*Typical case of mottled tooth enamel*

*Write today for Bulletin 2500, which completely describes Defluorite Purifiers.*

**INTERNATIONAL FILTER CO.**

59 E. Van Buren St., Chicago, Ill.

(Continued from page 14)

nel in which is located a 24-inch standard pressure water main which passes under this navigable waterway. Regarded as one of the most hazardous tasks undertaken by the Works Progress Administration in the Buffalo area, extra precautions have been taken in safety measures to prevent injuries to the workers, under orders from WPA officials.

Eighty-four men are working on the reconstruction of the tunnel. The majority of the workers on this WPA project are classified as skilled mechanics. Each is equipped with steel helmet and safety belt as he toils far beneath the street level in a tunnel that is six feet, six inches in height and 340 feet in length. This tunnel was built 32 years ago and the pipe line laid under the rock bottom river bed at the same time. Because of erosion the shaft on each side of the Buffalo river will have to be practically rebuilt and the pipe line, which has been thrown out of alignment, will be removed, cleaned, repaired and replaced.

On each side of the river is a circular shaft lined with concrete and reinforced steel eight feet in diameter and sunk to the depth of 69 feet. Connecting these two shafts is the tunnel that contains the water main or pipe which is supported at 12-foot intervals by heavy steel beams of 12-

(Continued on page 18)

The logo consists of the word "DIFCO" in a bold, sans-serif font, enclosed within a stylized, rounded rectangular border that resembles a metal plate or a badge.

### PLATE COUNTS OF COLI

**Bacto-Brilliant Green Lactose Bile Agar** is an excellent plating medium for direct counts of the coliform bacteria in water. This medium is prepared in strict conformity with the formula of Noble and Tonney as recommended in "Standard Methods of Water Analysis" 1936. After incubation for 18 hours at 37°C. typical colonies are deep red at the center and are surrounded by a pink halo in sharp contrast with the blue medium.

**Bacto-Violet Red Bile Agar** is also exceptionally well suited for the direct plate count of coliform organisms. On plates of this medium the coliform bacteria produce red colonies surrounded by a reddish zone of precipitated bile. Counts are made after incubation at 37°C. for 18 hours.

---

Specify "DIFCO"

THE TRADE NAME OF THE PIONEERS

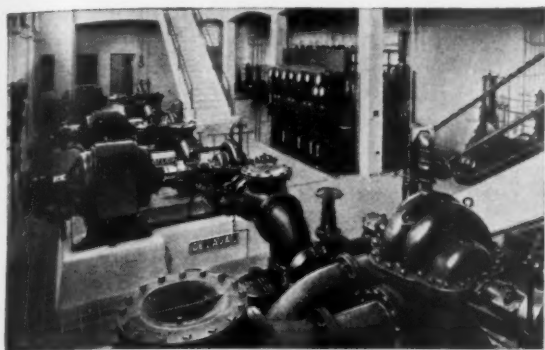
In the Research and Development of Bacto-Peptone and Dehydrated Culture Media

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**DIFCO LABORATORIES**

INCORPORATED

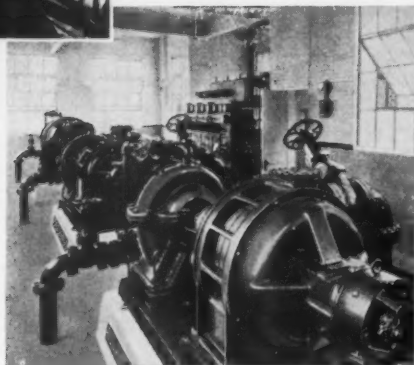
DETROIT, MICHIGAN



• Three De Laval pumps in City Pumping Station, driven by General Electric motors.

• Three De Laval pumps in River Pumping Station, driven by General Electric motors.

## **GRIFFIN, GA.** *Improves Water Works* *by installing* **DE LAVAL** **PUMPS**



**A**BOUT eight years ago Griffin, Ga., a textile center of about 11,000 population, decided to abandon its 20 deep wells in favor of taking water from the Flint River, about 9 miles distant.

Three De Laval pumps of 2 m.g.d., 3 m.g.d. and 4 m.g.d. capacities, respectively, and driven by synchronous motors, were installed in the River Pumping Station to force raw water against 325 ft. head to the City Pumping Station. The 4 m.g.d. pump has also, as standby, a gasoline engine of 420 b.hp. to drive it.

At the City Pumping Station, where the water is treated before distribution, there are three De Laval synchronous motor-driven pumps, one rated at 2 m.g.d., one rated at 3 m.g.d., and the third rated at 4 m.g.d. There is also a 5 m.g.d. standby pump directly connected to a gasoline engine, all against 120 ft. head. Recently, because of power failure during a sleet storm, the latter unit was operated 14 hours continuously.

This strikingly handsome plant, located on the main highway to Atlanta, is in charge of Mr. Lewis Siminton. Mr. H. P. Powell is Superintendent of the Light and Water Departments.

- *American cities have installed to date De Laval pumps aggregating more than 15 Billion Gallons daily capacity*

4095

# DE LAVAL

*Steam Turbine Co.*  
 TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES, PUMPS—CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, CENTRIFUGAL BLOWERS AND COMPRESSORS, WORM GEARS, HELICAL GEARS, HYDRAULIC TURBINES, AND FLEXIBLE COUPLINGS—SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM

(Continued from page 16)

inch dimensions. These beams are imbedded in the concrete wall of the tunnel.

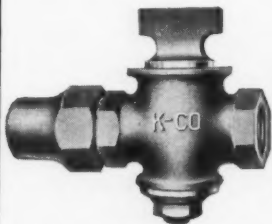
Under the WPA project, new ladders will be installed in these shafts and all steel supports cleaned and repaired. A new vault will be built to house the 24-inch valve on the north side of the river tunnel. Work on the shaft part of the project started in November, and it is expected that reconstruction of both shafts and the standard pressure water main will be finished by March. The cost of the project has been estimated at approximately \$10,000.

**Trouble comes in bunches**, at least according to the case of Parkersburg, W. Va., where three major repair jobs due to emergencies were under way on one week-end. First, on a Friday afternoon a six-inch water main "blew up." The line was under trolley tracks and so necessitated considerable work to make the repair. This emergency was ascribed to electrolysis. Second was the breaking of a six-inch valve on Saturday. This closed off several blocks from water supply until the following day. Third and last trouble was the appearance on Sunday afternoon of a cave-in, ten feet

(Continued on page 20)

## KITSON ROUNDWAY STOPS - *Finest Quality*

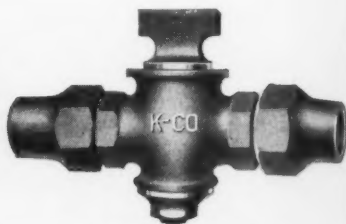
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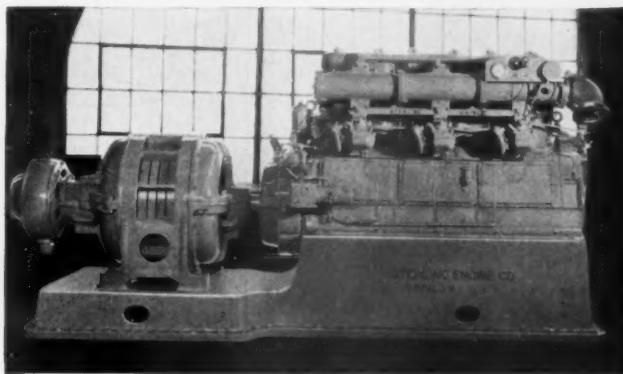
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(Continued from page 18)

square and six feet deep, in one of the main streets. A sanitary sewer 23 feet under the surface had caved in and required considerable care and time to repair due to the presence of quicksand. It is said that at least a dozen such cave-ins have occurred since the 1937 flood in Parkersburg.

Springfield, Ohio, has started work on a water supply improvement project that will cost over one million dollars, including WPA aid. This work is finally started after considerable opposition by citizens who wished to prevent higher water rates. An editorial of the Springfield, Ohio, *News* states the case clearly:

"Those who might be inclined to criticize the action of the Springfield City Commission in proceeding with definite plans for improvement of the city water works department, are overlooking two very essential facts:

"First, the city is under a definite order of the Ohio Supreme Court to make an improvement in its water works department to meet the requirements of the state board of health. The plan contemplated by the city meets the approval of the board.

"Second, immediate action by the commission looking to carrying out

(Continued on page 22)

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(Continued from page 20)

of its plan is essential in order to obtain the government grant of 45 per cent of the cost—otherwise the city must bear the entire cost of the project.”

Springfield has hope of further reducing its water works improvement cost due to projected plans of the War Department for Army engineers are expected to make a favorable report on the local flood control project for the next session of Congress, in which case Springfield would probably be saved the expense of building a dam. R. E. Crawford and D. H. Maxwell, associated with Alvord, Burdick and Howson of Chicago, are preparing the preliminary plans for the city's project.

Grand Rapids' proposed pipeline project, which is expected to cost over \$4,000,000, is being subjected to detailed study. Arthur W. Consoer, consulting engineer for Grand Rapids, has submitted plans for the 30-mile pipeline which were opposed by the Grand Rapids Engineers Club and the city group of the National Association of Power Engineers.

As a result of this opposition, Mr. Consoer is having two experts check on plans for the project. Thomas Wiggin, noted for his work on the New

(Continued on page 26)

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WATER WORKS - SEWERAGE - UTILITIES

Baltimore, Md.

Albany, N. Y.

*(Continued from page 22)*

York Catskill water supply and other major water supply projects, and Prof. F. M. Dawson are the experts submitting reports for Mr. Consoer. Cost and practicability of using a tunnel or pipeline are to be considered. The proposed tunnel would be 54 inches and the pipeline 46 inches in diameter.

**Gerard Swope**, President of the General Electric Company, through his service with the President's Commission on Industrial Relations in Great Britain and Sweden, found that "abroad coöperation on industrial questions was three-cornered, between industry, labor and government." Portions of his address before the National Association of Manufacturers follow:

"It must be borne in mind that in Great Britain the term 'trade union' is not limited in its meaning to labor unions. It embraces combinations of employers as well as combinations of workers to regulate the relations between employers and workers, or among workers, or among employers; or to impose restrictive conditions on the conduct of any trade or business, or to provide benefits for members. This is true also in Sweden.

*(Continued on page 28)*

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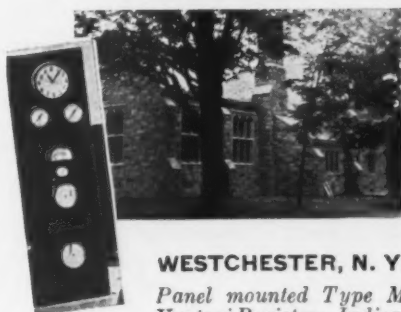
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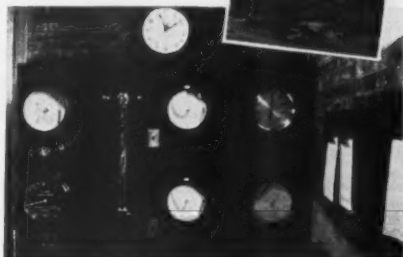


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Why not use it in your plant and benefit thereby?

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(Continued from page viii)

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HARDIN, EUGENE A. from Michigan to Illinois.

HOFFMAN, FLOYD A. from New Jersey to Florida.

LYNCH, JAMES H. from New York to Ohio.

TETZLAFF, FRANK. from South America to New York.

(Continued from page 26)

"The second fundamental is the difference in conception of collective bargaining. The definition of collective bargaining in Great Britain, and also in Sweden, is that "Collective agreement" does not mean an agreement between a single employer and his workers, or even an agreement between a single employer and a union. It means an agreement negotiated collectively by representatives of a group or association of employers (commonly an industry-wide association), and representatives of a union or a group or association of unions.' In this country, except in a few industries, this has not been attempted, even if it has been considered. There has been no unanimity on the part of the managements of different companies in the same industry to have a common labor policy. It must be remembered that in both Great Britain and in Sweden this has come about as a defensive and militant measure. The employers finally decided to unite to combat the increasing strength of the unions. This resulted in industry-wide associations, which is now the general rule in both countries.

"In addition, there are three other important factors. First, in Great

(Continued on page 30)

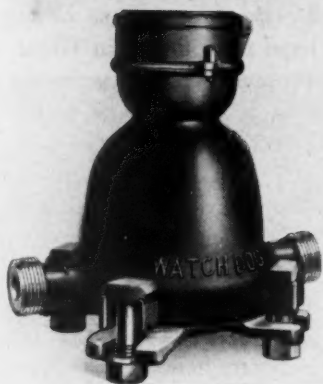
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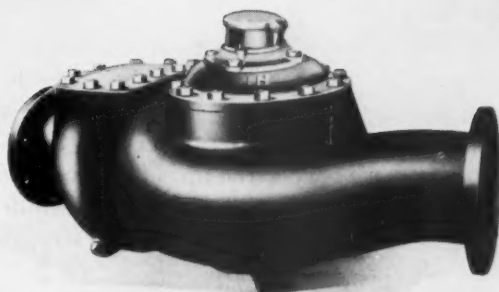
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## WORTHINGTON-GAMON

(Continued from page 28)

Britain and Sweden both workers and employers desire that all agreements be negotiated freely by their representatives and all conclusions be voluntarily arrived at, without compulsion by the government or any other outside force or agency. There is no legal compulsion in Great Britain to deal with labor unions, to recognize the representatives elected by the majority of employees of a particular firm, or to do away with so-called 'Company Unions.' In fact, some employers do not recognize the unions.

"Second, from experience and combat, but now as a result of meeting each other and frank discussions on the questions involved, workers are treated with respect and grievances are dealt with and disposed of promptly. It has been recognized, as a result of experience, that higher pay does not necessarily remove grievances; it may be only a brief palliative. The increase in pay is always acceptable but the grievance may remain and rankle. As one of their wise and experienced labor leaders said, 'Chase grievances; then it becomes unnecessary to chase Communists. . . .

"And third, to accomplish results under such methods calls for patience in negotiation, respect of each side for the other and time for the development of leadership and understanding, so that the scope of the questions presented will be well understood and a reasonable attitude assumed in determining what the immediate aim should be and what should be striven for in the future. This has not been developed in a day. This has only been accomplished as a result of struggles over a long period of time.

"It must be remembered, too, that in Great Britain when contracts are entered into by the employers and unions in an industry, they are not legally enforceable but rest on a moral basis only. . . . In Sweden, if a difference in the interpretation of the agreement arises, it must be taken to the Labor Court and the decisions of the Labor Court are final and binding upon both sides, and no strike may occur while the agreement is in effect.

"Trade unions in Great Britain, which formerly had no legal status, have now come 'to a state in which trade unions (employers and workers) not only have a recognized legal status but they have been given immunity from any charge of restraint of trade and, with respect to their activities in contemplation or furtherance of a trades dispute, from any action for civil or criminal conspiracy. . . .'

"There is no law against peaceful picketing, nor espionage, nor strike breakers—called 'Blacklegs' in Great Britain. Strikes still occur, but with relatively little violence. Espionage and strike breakers have disappeared, not by law but because of general recognition of the right of the workers to organize. The unions recognize the right of the employer to manage, and to hire and fire workers without regard to whether they are union members or not. . . .

(Continued on page 32)

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Save for ultra-speed photography, you'd never see this "crown" created by a milk drop splash on a plate. We wish it were possible to show you the increased qualities in Trident Meters as vividly . . . we wish we could picture the closer tolerances, the finer finish, the standards of ultra-precision made possible by the modern precision machine tools and production methods used in the Neptune shops today. But you *can* easily see the results . . . in higher percentages and closer range of accuracy, perfect interchangeability, longer life, lower maintenance costs . . . these are the crowning proof of Trident Meter leadership.



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with turbine or propeller for  
high rates of flow  
Sizes  $1\frac{1}{2}$ " and 2" Screw End  
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(Continued from page 30)

"In neither Great Britain nor Sweden is the working week as short nor the standard of wages as high as in the United States, both in terms of money and in time required for the workman to secure the essentials of life—food, shelter and clothing.

"In both countries the governments have organized divisions of conciliation, but the acceptance of conciliation is entirely voluntary—not mandatory—for each side, employer and worker, to accept. Even when accepted, the determination is not necessarily binding, but is generally followed. Both sides object to compulsory arbitration.

"In Great Britain, Trade Boards for the unorganized trades may determine minimum wages and maximum hours. These Boards are made up of employers and workers in equal number as to votes, with a group of impartial men selected by the government. . . .

"Social security has been in effect in both countries for a number of years and has had a beneficial effect on industrial relations. In Great Britain, the unemployment insurance, old-age pensions and invalidity insurance are on a three-way contributory basis, by the employee, the employer and the Government. In Sweden, these are borne entirely by the employee and the Government. In our own country, old-age pensions are borne by the employer and worker, in equal amounts. Unemployment insurance, on the other hand, varies in the different states; in some it is borne entirely by the employer, in others in part by the employer and in part by the worker. In some states an incentive—a lower tax—is given the employer if he reduces unemployment by stabilizing the work or guaranteeing a minimum annual wage. In both Great Britain and Sweden, as well as in the United States, workmen's compensation is borne entirely by the employer.

"The development of industrial relations in Great Britain and Sweden has taken time. Conditions and mentalities there are quite different from those that obtain here, so their methods cannot be transplanted as a whole.

(Continued on page 34)

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*with the lowest maintenance*

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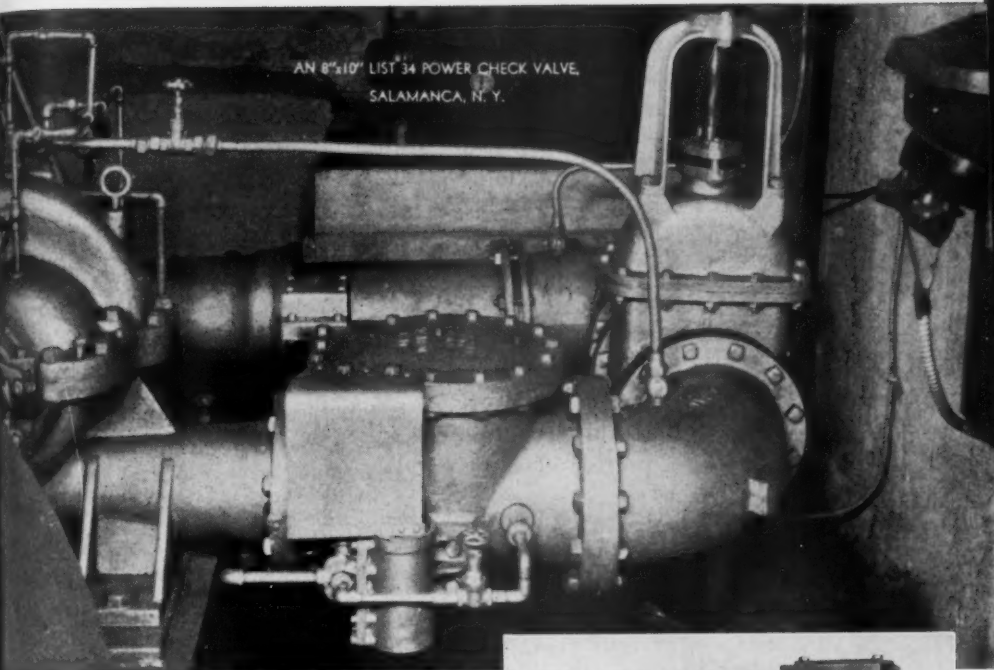
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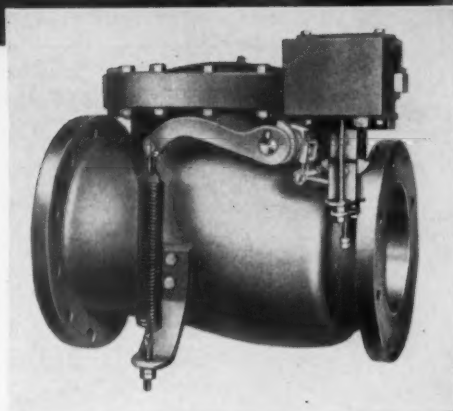


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(Continued from page 32)

However, we should study what has happened over there and profit by their experience. The fundamentals of that experience are:

1. Growth and development of strong organizations of both employers and workers.
2. Self-regulation of employers associations and workers organizations.
3. Mutual respect, the one for the other.
4. Voluntary—not mandatory—recognition of each other.
5. Voluntary agreement to negotiate, rather than to fight.

"These are along the lines of our thought, politically, and therefore not basically inconsistent, industrially. We have made progress, but much still remains to be done. When accomplished, not only will employer and worker have gained, by substituting reason as a way of settling differences, but the country will be spared strife and violence; a large number of constructive man-days of work will be saved each year, and we will have industrial peace."

The Public Works Administration on December 28 released a report to the President which recorded the fact that the 1938 program had put under contract 7,853 projects calling for the expenditure of \$1,574,769,686.

Applications for 12,814 projects were made, thus evidencing a desire for more work than could be authorized under the present program. Here-with is quoted a portion of the report:

"Projects erected under the PWA program will benefit all the people. They were selected by communities which were willing to assess themselves 55 per cent of the total cost. What America wants in public works is illustrated by the principal types included in the 1938 program. These types included:

TYPES OF NON-FEDERAL PROJECTS	NO. OF PROJECTS	TOTAL ALLOTMENTS	TOTAL ESTIMATED COST
Streets and highways.....	598	\$108,409,689	\$238,705,516
Sewers, waterworks, power and other facilities.....	1,436	142,167,044	289,762,218
Educational buildings.....	2,808	220,907,508	469,195,114
Other buildings.....	945	119,102,260	242,833,273
Flood control, water power and reclamation.....	29	11,929,305	14,185,683
Water navigation aids.....	21	5,946,829	11,937,404
Engineering structures (Bridges, tunnels, etc.).....	197	67,918,288	145,401,138
Miscellaneous.....	212	16,844,362	26,560,438

## NEWS OF THE FIELD

**Water witching**, or the use of a forked twig, or so-called divining rod, for locating minerals, finding hidden treasure, detecting criminals, and other purposes, is a curious superstition that has been a subject of discussion since the middle of the sixteenth century and still has a strong hold on the popular mind, even in this country, as is shown by the large number of inquiries received each year as to its efficacy, especially for locating underground water, and the persistent demands that it be made a subject of investigation. This study has been made by the United States Geological Survey.

In its most familiar form this device consists of a forked twig, one fork of which is usually held in each hand in such a manner that the butt end of the twig normally points upward. The supposition is that when carried to a place beneath which water or certain minerals lie, the butt end will be attracted downward, or, according to some diviners, will whirl round and round. There are many modifications in both the form and the manipulation of the device. Some diviners appear to pass into abnormal or psychical states and have muscular spasms, such as occur in cases of hysteria, which, it is contended, can not be repeated at will by the diviner when he returns to a normal state.

In tracing the history of the subject it is found that divining rods have been used to locate ore deposits, to discover buried or hidden treasure, to find lost landmarks and re-establish property boundaries, to detect criminals, to analyse personal character, to cure diseases, to trace lost or strayed domestic animals, to insure immunity against ill fortune when preserved as a fetish, *to locate well sites, to trace the courses of underground streams, to determine the amount of water available by drilling at a given spot*, to determine the depth at which water or ores occur, to determine the direction of cardinal points, to determine the height of trees, and to analyse ores and waters.

The origin of the divining rod is lost in antiquity. What is believed to be the first detailed description of it is contained in Georgius Agricola's "*De re metallica*," which was published in 1556. About that time divining rods came into common use in Germany for locating mines and discovering buried treasure. The device was introduced into England during the reign of Elizabeth (1558-1603) to locate mineral deposits, and soon afterward it began to be used as a "water finder" in many parts of Europe.

Everywhere the practice of water witching aroused controversy. Its champions attempted to explain it on the principle of "sympathy" or "attraction and repulsion," this explanation doubtless being suggested by

(Continued on page 2)

(Continued from page 1)

the phenomena of gravity and magnetism. Its adversaries, on the other hand, condemned it as a superstitious and vain practice. Some held that the twig was moved by a satanic influence, and others that the operator possessed a divinely given faculty. It was no doubt with the purpose of avoiding the odium attached to dealings with the Evil One that it was surrounded with ceremonies and formulas of a highly pious character. Sometimes the rod was duly Christianized by baptism, being laid for this purpose in the bed with a newly baptized child, by whose Christian name it was afterward addressed. About 1660 the Jesuit Father Gaspard Schott denounced the divining rod as an instrument controlled by the devil, thereby identifying it with witchcraft and bringing it within the jurisdiction of the Church. The subject was then taken up by the Church, and for more than 100 years it was hotly debated by churchmen.

In the later part of the eighteenth century the study of electricity made great progress, and the demonstration by Galvani that amputated legs of frogs could be made to twitch under the influence of electrical stimuli was at once misinterpreted by advocates of the divining rod as giving a scientific basis for water witching. Many other attempts have been made to explain water witching as an electrical phenomenon. Recently various elaborate investigations have been undertaken to determine whether certain so-called water witches possessed clairvoyant powers, thus relegating the subject to the obscure realm of occultism.

A truly astonishing number of books and pamphlets have been written on this uncanny subject. It is doubtful whether so much investigation and discussion have been bestowed on any other subject with such absolute lack of positive results. It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited, and it should be obvious to everyone that further tests by the United States Geological Survey of this so-called "witching" for water, oil, or other minerals would be a misuse of public funds.

The foregoing paragraphs are abbreviated from a history of water witching, by A. J. Ellis, which has been published by the United States Geological Survey as Water-Supply Paper 416. This paper, which also contains a long list of publications on the subject from the sixteenth century to the present time, is for sale by the Superintendent of Documents, Washington, D. C., at 15 cents a copy.

**An innovation in the annual index** to the JOURNAL, which is mailed as a supplement to this issue, is an "Index of Abstract Topic Headings" on pages 2136-2137 of the index. This form of subject index to the abstracts is derived from the subject classification of abstracts which has

(Continued on page 4)

# TAXES- PEOPLE & PIPE

**T**AXES, people and pipe are three live subjects discussed in The Cast Iron Pipe Research Association's advertising in national publications read by influential citizens, featured by the slogan, "Public Tax Saver No. 1," which has created widespread interest. This educational advertising is for the purpose of *supporting public officials* in specifying a material which, though lowest in cost per service year, is frequently higher in first cost.

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It is to the advantage of water works officials that the public shall realize that water mains represent about one-third of this country's 5-billion-dollar investment in public water supply systems—that more than 98% of these mains are cast iron pipe with a *known* useful life at least double the *estimated* life of other water main materials—that the consequent tax-saving, through deferred replacements alone, is enormous—and that cast iron pipe is entitled to be advertised as Public Tax Saver No. 1.



Look for the "Q-Check" registered trade mark.  
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## CAST IRON PIPE

### PUBLIC TAX SAVER NO. 1

(Continued from page 2)

been in effect for some time. It is an adaptation of a method of reference which has been found useful in the JOURNAL editorial office.

The subject indexing of abstracts has been a troublesome problem. It has not been certain that the value of such an index justified the labor required in its preparation or the expense of its publication. And yet, in its conventional form, it could not be condensed without destroying its usefulness entirely.

Comments by readers will be welcomed to assist the staff in determining whether the "Index of Abstract Topic Headings" may or may not satisfactorily replace the subject index of abstracts as it has appeared in the past.

Income levy for federal, state and local employees was approved by the House of Representatives on February 9 when it passed a bill providing for federal taxation of all government workers on the same basis as private individuals. The bill gives the states express permission to tax federal employees. Water works men who are interested and who have not put their views before their Congressman should do so at once.

(Continued on page 6)

## For Underground Service Lines

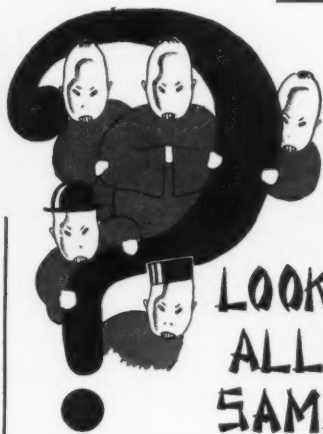
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6" or 36"—all pipe diameters look alike to Tegul-MINERALEAD. It makes tight, trouble-free joints in any sized pipe. • Quick healing, initial leakage stops almost at once — trenches can be backfilled and streets cleared up • 10 lb. ingots easily handled, stored and shipped; impervious to rain, snow and flood • For more information, write The Atlas Mineral Products Company of Pa., Mertztown, Penna.

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**MINERALEAD**

## *New Materials and Gadgets*

1. **Non-Skid Paint** that is guaranteed, when applied according to directions, to remove all slipperiness from steel or concrete floors and from steel or wood stair treads has been placed on the market. The result is obtained by the use of a varnish vehicle for stainless steel flakes.

2. **A Flash Wrench** is a new device designed to enable the mechanic to achieve exactly the right tension in setting up on anything from cylinder head studs to spark plugs. The socket wrench has five different tension scales. A warning flash comes from a built-in flashlight battery and bulb as a certain tension is reached.

3. **Protecting Shoes** against effects of hot, cold or wet floors is the purpose of a modern Roman sandal worn over street shoes. Soles are  $\frac{1}{2}$  inch thick and made from automobile tire casings.

4. **Weather-Tight Bolts** have been designed to fit bored holes in wood as though they were corks in bottles. Tapered splined shanks on the bolts are reported to enable drawing the bolt down flush without counter-boring and thus producing a smooth weather-resisting surface of wood.

5. **A Consumption Meter** has been put on the market to be used to measure the actual fuel consumed by an engine, truck, or auto. It is based upon the positive displacement principle and is to be attached to any liquid-fuel-consuming vehicle.

6. **Drain Persuading** is the purpose of a device developed to use the combined forces of hot water and compressed air to clear drains of grease. By means of a hose connection, hot water is used to soften the grease, and then suddenly applied air pressure clears the drain.

7. **Aluminum Surfaced Roofing** has been developed to provide a roof that reflects heat instead of absorbing it. Ceramic granules coated with aluminum cover the weather surfaces of the shingles.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items.

(Continued from page 4)

In order to bring together federal officials concerned with public works and citizens especially qualified to advise on the economics and timing of public construction activities, the National Resources Committee has announced the appointment of a Technical Public Works Committee.

Colonel Henry M. Waite was named chairman of the Committee and Frank W. Herring of the American Public Works Association, vice chairman. Other members are F. E. Schmitt, Engineering News Record; Otto T. Mallery, member Pennsylvania State Planning Board; William Stanley Parker, Construction League of America; Frederick J. Lawton, Bureau of the Budget; Corrington Gill, Works Progress Administration; Fred Schnepfe, Public Works Administration; Lowell Chawner, Department of Commerce; A. F. Hinrichs, Department of Labor, and Lt. Col. Paul W. Baade, War Department.

This group has been asked to assist the National Resources Committee in continuing its preparation of 6-year programs of federal public works and in stimulating the preparation of such capital budget programs by states and cities. In addition the new committee will undertake studies to determine the most effective utilization of state and local public works

(Continued on page 8)



An electrical appliance which eliminates Rusting, Corrosion, Pitting and Painting below the water line in Steel Water Tanks.

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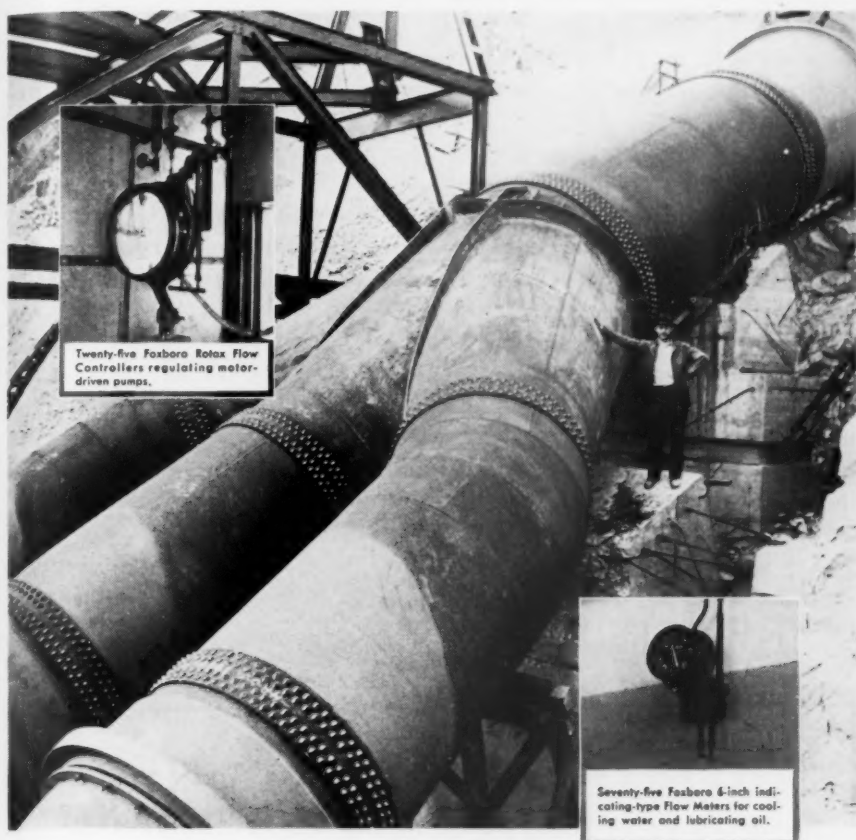
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Measure, Mix and Feed Chlorine Gas Accurately for Water Works, Swimming Pools and Sewerage Purification with EVERSON SterElators.

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Seventy-five Foxboro 6-inch indicating-type Flow Meters for cooling water and lubricating oil.

## FOXBORO FLOW METERS on the Colorado River Aqueduct

In this huge project 25 Foxboro Rotax Flow Controllers were selected to control pumps; 75 indicating-type Flow Meters to measure the flow of cooling water and lubricating oil in the operation of the large-sized pumps and motors in the main aqueduct pumping plants. . . . Foxboro Instruments were chosen for reliability, accuracy and long life — features which are inherent in the design and construction of all Foxboro Controls. Water, irrigation, filtration and disposal systems in ever-increasing numbers are being put under control by Foxboro Instruments. Designing engineers and operators know

that truly economical instrumentation demands uniform, unfailing service from the instruments. That . . . plus the fact that Foxboro offers a complete line of proved instruments . . . explains this growing demand. . . . Foxboro's thirty years' experience in the measurement and control of flow, pressure, temperature, and liquid level is at your service. For complete information write to

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**FOXBORO**  
Instruments

**FOR WATERWORKS AND SEWAGE SYSTEMS**

(Continued from page 6)

for stabilizing the construction industry and to analyse the plan of public construction activities in providing employment and increasing the national income.

This work will continue work carried on by the National Resources Committee since the abolition of the Federal Stabilization Board which was required to prepare advance public works programs under the Federal Employment Stabilization Act of 1931. That act declared it to be the policy of Congress to develop a reservoir of projects arranged in order of proposed work for a period of six years in advance.

The program prepared by the Stabilization Board proved of great value in the quick development of federal projects at the outset of the work of the Public Works Administration and the appointment of the new Technical Public Works Committee is expected to expedite the preparation of such programs by the National Resources Committee and to increase local and State activities in this direction.

**Rotary displacement pumps** for handling oils are described in a new publication of the De Laval Steam Turbine Co., Trenton, N. J. The pump is described as having only three moving parts, a power rotor and

(Continued on page 10)

## EDSON DIAPHRAGM PUMPS

Hand Operated—size 2", 2½", 3", 4"

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Open Discharge or Force Pump  
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Hartford, Conn.  
Manitowoc, Wis.  
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The Water Department of Chicago and the Chicago Union Station were jointly and seriously concerned about the material to use in the 36" line to replace pipe running under the tracks of the station. The answer, illustrated above, is Alco Electric Welded Steel Pipe. No further need to worry about disastrous breaks.

## ALCO FEATURES

Greater Strength  
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Smoother Waterway  
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also manufacturers of the well known **INVERSAND** water softener

*(Continued from page 8)*

two sealing rotors, which carry helical teeth that mate as they roll to form enclosures traveling continuously from suction to discharge. This is said to result in a steady delivery without pulsation. The pumps are designed for a wide range of capacities and pressures and to be coupled to steam turbines or electric motors.

**Frank D. H. Lawlor**, Superintendent of the Citizens Water Company of Burlington, Iowa, and a member of the Association since 1906, died January 25, 1939, after failure to recover from an emergency appendicitis operation. Mr. Lawlor was 82 years old.

Born in St. John, New Brunswick, Mr. Lawlor attended the Christian Brothers school and at the age of seventeen entered the office of city engineer in his home town as a student without pay. The English system provided that a student serve four years gratis. Later he secured a position on the staff of the superintending engineer for the Maritime province of the department of public works in Canada. He was about 24 years old when he decided to come to the United States where he secured a job in the engineering department of the Burlington railroad.

*(Continued on page 12)*

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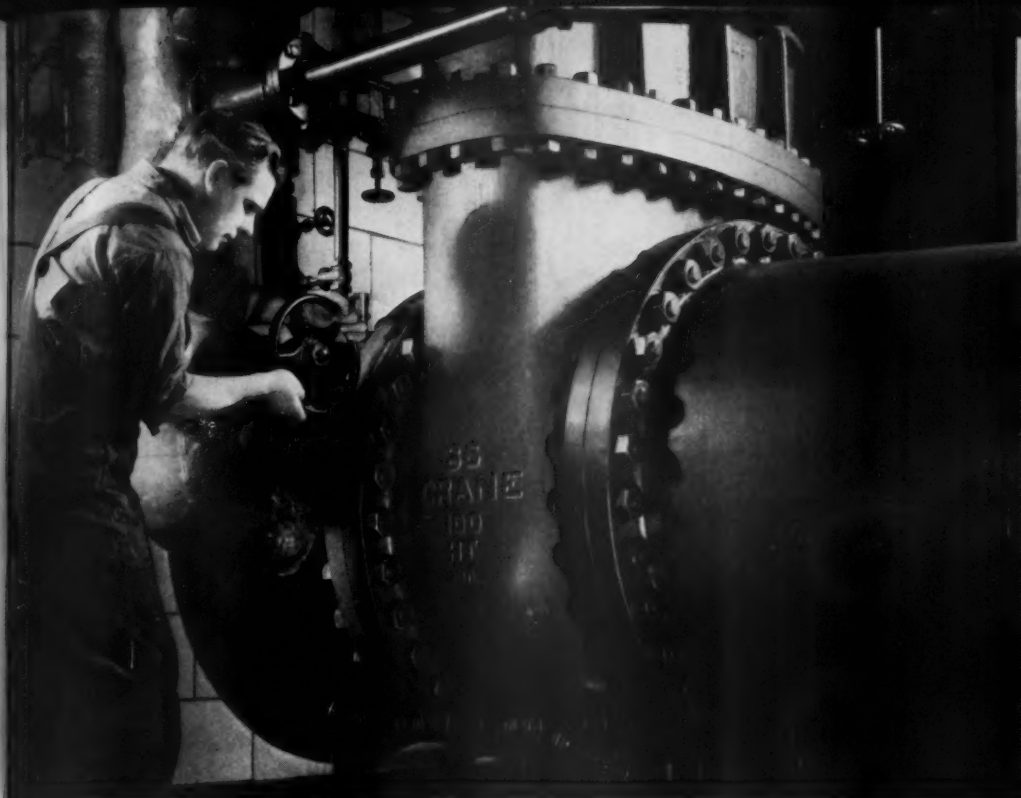
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ter works valves—be sure they'll meet tomorrow's needs.

And they will—if you choose Crane No. 480 1/2 A. W. W. A. double disc gate valves. They're built to give that kind of service—scientifically designed for positive action... smooth, yet tight and true—through long years ahead.

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Your water system makes your city livable... is the lifeblood of its industry. It's the true foundation of your city's future. Be mindful of this when you buy water works valves—be sure they'll meet tomorrow's needs.

## BIG VALVES FOR BIG JOBS IN FLOW CONTROL

**W**HERE the big job requires a big valve there is, in the Crane line, a valve of just the right size, just the right design to handle it. Here, for example, is a 36-inch gate valve chosen by the waterwork engineers of a large mid-western city to control the flow of water from the pumps into the city mains. It's Crane, of course, for Crane quality is well recognized by experienced engineers as a highly desirable plus value in valves where the requirements are a little exacting—the service a little tougher.

But important as big valves for big jobs are in flow control—little valves for big jobs are important, too. For example 1/2-inch valves that just make a handful, control the service line shut-off into homes—special plug disc valves handle the chlorine and give greater resistance to the corrosive action of this gas. But whether it is a valve so large a man can walk through it or so small you couldn't use it for a finger ring—the Crane line covers them all.

Regardless of your requirement—if it is valves, fittings or piping for waterworks or sewage treatment service—you will find it in the Crane line. Turn to your Crane No. 52 Catalog for the details about 38,000 items. Among them you will find an answer to practically any piping problem which you may have. You will also find a large amount of engineering data which may prove very desirable to have handy.

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VALVES • FITTINGS • PIPE  
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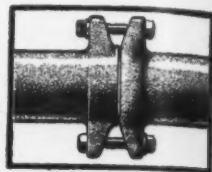
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No other tools are needed. No lead, no pouring, no bell holes to dig. Machined iron-to-iron flexible joints. **SPEEDIEST...EASIEST...SAFEST.** Highest quality Cast Iron.



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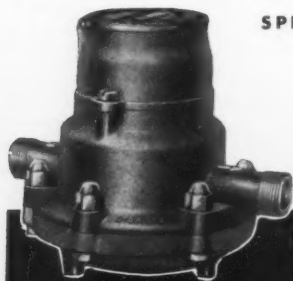
(Continued from page 10)

Before being named superintendent of the Citizens Water Company in Burlington, in 1903, he had been to Uruguay, South America, for the purpose of helping build railroads there, had returned to make surveys in the Black Hills for the Burlington railroad, had gone back to New Brunswick to enter the contracting business in building the Tubique Valley railroad, had been assistant engineer at the enlargement of the Galops canal at Cardinal, Ontario, and had been in charge of contract work at Port Colborne, the upper end of the Welland canal. Mr. Lawlor was an active worker in the water works field and well known by his attendance at conventions and meetings.

Three men had worked a total of 142 years when they retired January 1 from the Los Angeles Department of Water and Power. The January issue of *Intake*, publication for the employees of the Los Angeles Department of Water and Power, explains that Thomas J. Brooks, Superintendent of Street Mains, retired after 55 years of service; Fred J. Fischer, Chief Mechanical Engineer, retired after 49 years of service; and George D. Pessell, Cashier of the Department, retired after 38 years of service.

(Continued on page 14)

## FIRST QUALITY METERS EXCLUSIVELY



SPECIFY

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(BRONZE CASE) (IRON CASE)

*Water Meters*

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The latest to be installed is the 80 m.g.d. unit at Springfield, the official acceptance tests of which were made in June, 1938. Using steam at 175 lb. gage with 150°F. superheat and pumping against 187 ft. head, a duty of 222.8 million foot pounds per thousand pounds of steam, as corrected to contract conditions, was obtained.

This unit has been in continuous service since started in May, 1938. A delivery rate of 96 m.g.d. has been maintained on several occasions and 110 m.g.d. has been reached.

*Our engineers will be glad to submit valuable engineering and economic data on pumping upon learning of your requirements.*

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**DE LAVAL**

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*(Continued from page 12)*

Mr. Brooks first worked with the Los Angeles system as a two-dollar-a-day laborer on the Buena Vista reservoir in 1883. In the 55 years since then he supervised the laying of all water mains and trunk lines in the city, excepting only those in San Fernando Valley. Mr. Brooks is an honorary member of the American Water Works Association. He was born in Grass Valley, California, in 1862 and has been a resident of Los Angeles for 70 years.

Mr. Fischer as chief mechanical engineer had charge of the city reservoirs and pumping plants. He joined the Citizens Water Company in 1889 as a steam engineer. When that company was acquired by the Los Angeles City Water Company in 1893 he was retained in service and was again retained in 1902 under the new municipal management. He is a member of the American Water Works Association and the American Society of Mechanical Engineers and is also a past president of the National Association of Power Engineers.

Mr. Fischer has been a resident of Los Angeles for 60 years, during all of which time he has been affiliated with the Native Sons of the Golden West, which gives him the title of longest resident Native Son in that city. He went there at the age of 20 from San Francisco, where he was born.

*(Continued on page 16)*

## THE STANDARD *for more than* **50 YEARS**

### WATER WORKS SPECIALTIES



Automatic Pressure Control  
Valves

Pressure Reducing-Altitude  
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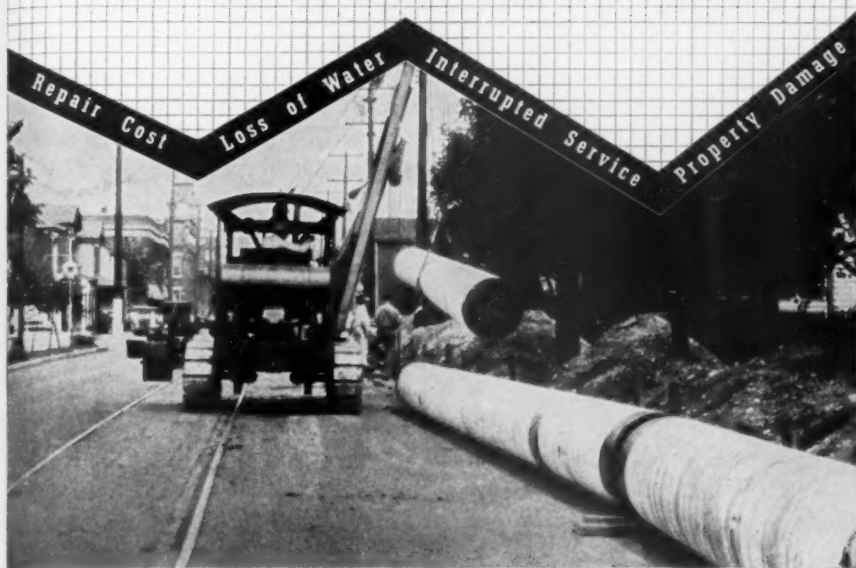
Portable Fire Hydrants

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**ROSS VALVE MFG. CO., INC. TROY, N. Y.**

# Save the Cost of Breaks and Leaks

## In Water Supply Lines



Why put up with the high cost of leaks and breaks in water supply and force mains? Now you can eliminate most of this trouble and expense by using Armco Spiral Welded Steel Pipe.

With Armco Pipe there's no danger of sudden breaks since the steel used has an ultimate specified strength of 50,000 to 60,000 pounds per square inch. Then too, it "stretches" 25 to 30% before the breaking point is reached. In addition, Armco Pipe assures strong, water-tight

joints that hold costly leaks to a minimum. When properly installed, Armco Spiral Welded Pipe keeps its line in spite of frost action, shifting soils or heavy traffic impact.

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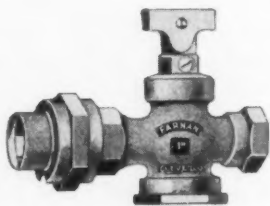
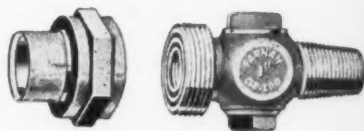
*(Continued from page 14)*

Mr. Pessell was cashier of the Department of Water and Power in Los Angeles for the past 25 years. His connection with the local water system dates from 1901 when he was appointed Zanjero, or water overseer, of the city's irrigation ditches. He was the last to hold that official title which was at that time considered an important municipal position.

Administrative changes in the Los Angeles department, some of them resulting from the above retirements, include: S. M. Dunn appointed mechanical engineer in charge of pumping plants and reservoirs, succeeding Mr. Fischer; Laurance E. Goit made engineer in charge of water distribution and operation, succeeding Mr. Brooks; E. W. Breitreutz appointed assistant to Mr. Goit; and A. I. Kelley placed in charge of the Personnel Coördination section. Mr. Kelley had been assisting B. S. Grant who was coördinator of personnel for the water Bureau before his appointment as chief assistant to J. E. Phillips, engineer of the Los Angeles Aqueduct. John R. Attwood became cashier of the Department, succeeding George D. Pessell who has retired.

*(Continued on page 18)**For tested Quality Specify***"FARNAN"**

You Benefit from Our 86  
Years of Manufacturing  
Brass Goods.



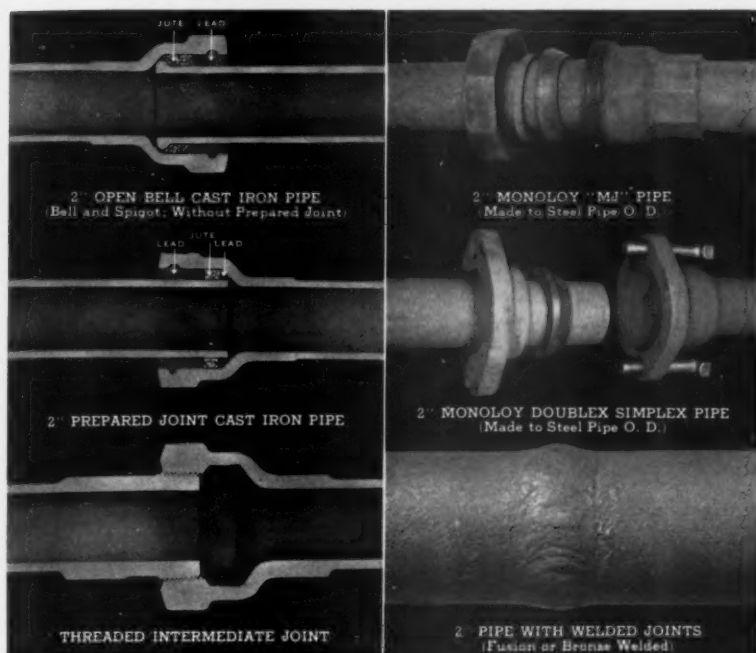
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"Acipco" 2-inch Cast Iron Pipe introduces the permanence, dependability and economy of Cast Iron Pipe into small service and distribution lines, building piping, small pump lines and various miscellaneous uses. "Acipco" was the pioneer developer and is one of the industry's largest producers of 2" and other small-diameter pipe. A wide variety of joints and complete line of 2" Cast Iron Fittings is available. Write for detailed information.



"Acipco" manufactures a complete line of Cast Iron Pipe and Fittings in diameters from 1 1/4" to 36" inclusive. Whatever your pipe requirements, address "Acipco" office nearest you, and enjoy peak quality of product and service from "America's Largest Individual Cast Iron Pipe Foundry."

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NEW YORK CITY    CLEVELAND    LOS ANGELES    SAN FRANCISCO

*(Continued from page 16)*

**F. E. DeMartini** has been appointed Associate Public Health Engineer in the U. S. Public Health Service and assigned to the Stream Pollution Investigations Station at Cincinnati, Ohio. Mr. DeMartini was formerly Sanitary Engineer of the San Francisco Water Department. His new duties are as assistant to H. W. Streeter, Senior Sanitary Engineer, who is in charge of the laboratory studies and field work of the Ohio River Pollution Survey which is being undertaken jointly by the U. S. Engineer Corps and the U. S. Public Health Service.

**Spicer, Minnesota**, has just drilled a well to the depth of 400 feet and obtained a supply of 250 gallons per minute. The project is being carried out with WPA aid and contracts for a pump, pump house, and water main are to be let about February 28, 1939. Druar and Milanowski of St. Paul, Minn., are consulting engineers.

**Charles McLaughlin**, Chief Engineer of the Zanesville, Ohio, Water Works, has retired after twenty years of service there. Mr. McLaughlin was a state examiner of steam engineers for three years previous to coming

*(Continued on page 20)*

## 80% Saving in fire hydrant collision repair costs

**I**MFACTS that would demolish any other type of fire hydrant merely fracture the inexpensive Safety Breakable Section of the Kennedy SAFETOP Fire Hydrant without injury to the major parts of the hydrant. The water pressure in the main keeps the inlet valve tightly closed, no excavating is necessary, nor need the water service in the vicinity of the broken hydrant be shut off while awaiting or making repairs.

Renewal parts cost only \$6.00 and can be replaced by one man in less than half an hour.

*Write for Bulletin*

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# KENNEDY SAFETOP FIRE HYDRANT

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# HERSEY COMPOUND METERS

excel any single unit or battery of meters for

**Capacity and Accurate Registration of all rates of**

**flow.— Self-contained bronze case up to 6 inches.**



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(Continued from page 18)

to Zanesville. Mr. McLaughlin's capability was highly praised by the Zanesville *Recorder* which said that his ability led many new mayors to retain him, "but the clamor for jobs on the part of the partisans of the new administration was too great to be ignored and [the present mayor] took advantage of the fact that Mr. McLaughlin had reached the pensionable age to retire him."

A. C. Colby, Jr., son of the president of the Chicago and Calumet District Transit Company, and the Gary, Heat, Water and Light Company, has been named to succeed Leo Besozzi as Hammond water department engineer. Mr. Colby is a graduate in mechanical engineering from Purdue University. At the age of 24, he is one of the youngest engineers employed in the Hammond water department. Mr. Besozzi resigned upon his appointment as one of three sanitary commissioners who are to control sewage treatment and garbage disposal in Hammond.

The water supply of Sandusky, Ohio, was blown away for several hours on December 27, 1938. The intake for the present Sandusky system is in a bay, and a 32-mile gale forced the bay water out into Lake

(Continued on page 22)

## THE FORD METER MITTEN

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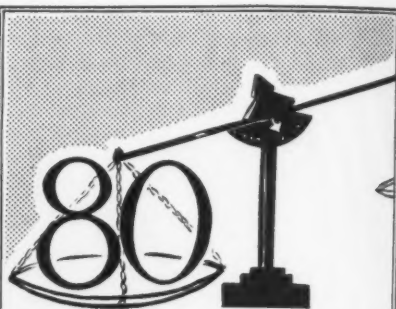
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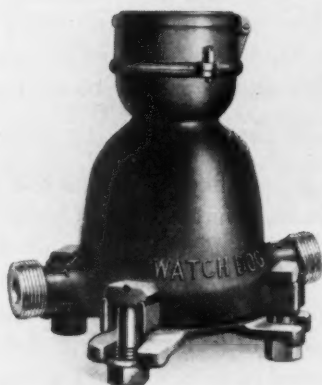
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Specification sheets on request.

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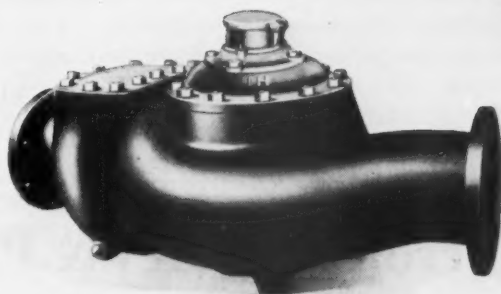
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General Offices: HARRISON, NEW JERSEY

*Offices and Representatives in Principal Cities*

# WORTHINGTON-GAMON

(Continued from page 20)

Erie leaving the intake holes in the crib gasping air instead of a water supply. Reserve supplies were drawn upon and the wind eventually changed direction, but it was not until December 30 that pumping schedules and reserves were normal. When Sandusky's new water system is completed, the intake will be in Lake Erie and not easily blown high and dry.

A Conference on air-conditioning is scheduled for March 8 and 9, 1939 at the University of Illinois, Urbana, Illinois. The Conference is sponsored by the Department of Mechanical Engineering and the Engineering Experiment Station of the College of Engineering at the University. Advance information from the sponsors says that technical information on current problems and apparatus involved in small and medium size installations is to be presented in as non-technical a manner as possible, in order to serve the small dealer, installer, owner, and prospective owner of air-conditioning equipment.

Among the papers scheduled are two bearing particularly upon the water works field: "Air-Conditioning Water Supply and Disposal" by

(Continued on page 26)

## Warren Foundry & Pipe Corp.

ALSO

Warren Pipe Co. of Mass., Inc.

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AMERICAN WATER WORKS  
ASSOCIATION

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*(Continued from page 22)*

W. D. Gerber, Engineer, Illinois State Water Survey, Urbana, Illinois; and "Conservation of Water by Using Cooling Towers and Evaporative Condensers" by S. I. Rottmayer, Mechanical Engineer, S. R. Lewis, Chicago, Illinois.

No admission is charged at this Conference which begins at 9:30 a.m. on March 8 at the Electrical Engineering Building at the University. The above mentioned papers will be given at the afternoon session on March 9. Complete programs and information will be mailed upon request by Professor W. H. Severns, Chairman, General Committee, 1939 Conference on Air-Conditioning, University of Illinois, Urbana, Ill.

The importance of scientific research and the part played in research by the Federal Government was emphasized in a report by the National Resources Committee transmitted to the Congress by President Roosevelt.

The report entitled "Research—A National Resource" was said by The President to be the first of a series of reports in this field. It was prepared by the Science Committee of the National Resources Committee and covers the relations of the federal government to the problem, while

*(Continued on page 28)*

## STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains—under paved streets, railroads or over bridges—you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

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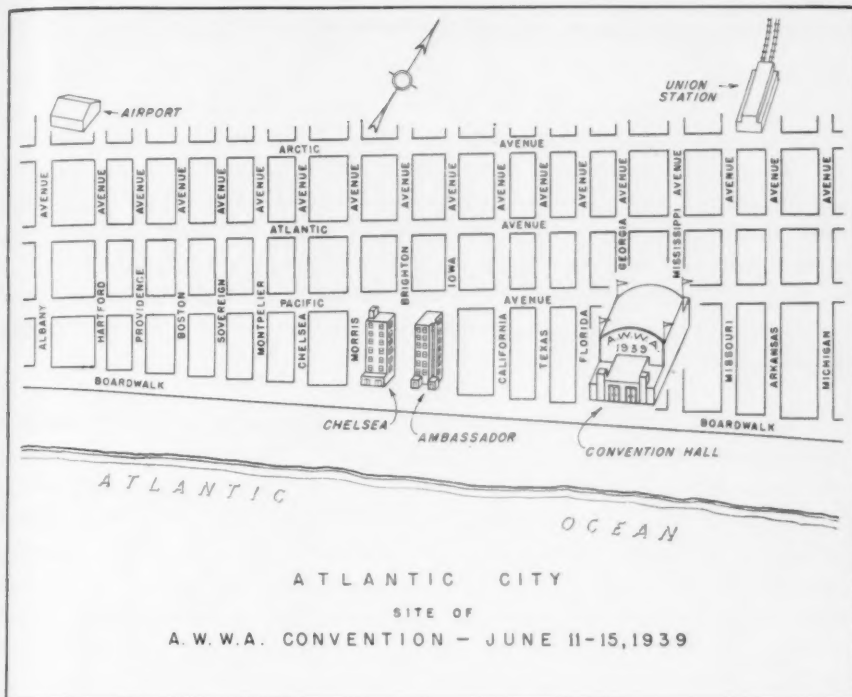


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One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

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208 E. Forsyth St., Jacksonville, Fla.

3812 Castellar St., Omaha, Neb.  
2587 Glen Echo Drive, Columbus, Ohio  
501 Howard St., San Francisco, Calif.  
58 Pelham Ave., Toronto, Canada.

(Continued from page 26)

later studies will be concerned with research by universities and colleges, by business organizations, by the large industrial laboratories, and by State and municipal governments.

The federal government, according to the report, spent on research approximately one dollar for each person in the United States during the fiscal year ending June 30, 1937. The \$120,000,000 spent in this field, however, represented only about 2 per cent of the total budget, in contrast to industrial corporations which spend about 4 per cent of their budgets on research and universities which spend as high as 25 per cent of their annual budgets.

**Lima, Ohio, has been given plans** for a program of expansion and improvement of the water supply system by E. E. Smith, Superintendent of the Lima department of water and sewage treatment. According to the *Lima, Ohio, News*, the program calls for an expenditure of over \$100,000 including WPA aid. This newspaper article shows the scope that may be practicable in presenting water works information to the public. It not only describes the need and possibilities of expansion and improvement and how these may be financed but also presents a review of past work and operation.

Need for the work is cited in the facts that the total safe capacity of the 1,350-million-gallon storage yields but a 6-month supply for Lima's 45,000 inhabitants and that in some years the total annual rainfall has not been sufficient to fill this storage. Mr. Smith has recommended the installation of two elevated filtered water storage tanks of one-million-gallon capacity each. These were recommended by a consulting engineer in 1937 and by the National Board of Fire Underwriters, the latter because Lima is dependent for water for fire protection upon continuous operation of its pumps. Elevated storage would ensure fire protection, a reserve in emergencies, and sustained pressure at times of peak load. Main extensions and equipment for utilizing digester gas from the sewage disposal plant are other expansions. Revenue from operation and WPA aid would obviate issuing bonds.

Current costs and analyses of pumping, purification and distribution operations are given. Slack coal cost \$2.88 per ton in 1938 compared with \$3.27 in 1937, an estimated saving of \$1,430 resulting. This year, the second of automatic stoker operation, an average of 10.0 lb. of steam per lb. of coal was attained compared with 6.5 lb. of steam per lb. of coal before use of stokers. Research on the use of sodium silicate and aluminum sulphate for water softening is reported as well as surveys of leakage from the distribution system.

(Continued on page 30)

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● Reilly Pipe Enamel and Primer provide a smooth mirror-like protective coating, securely bonded to the metal surface. This coating, highly resistant to abrasion, is unaffected by wide temperature variations. Will not crack or chip at temperatures as low as minus 20° F. Will not flow or sag at temperatures approaching 200° F. Dependable protection against corrosion, rust, incrustation and tuberculation is assured. Complete information regarding these coatings and methods of application will be furnished upon request.

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(Continued from page 28)

**Columbus, Indiana**, has installed the post card system of meter reading. When the meter reader cannot reach the meter when he calls, he leaves a self-addressed post card with the request that some member of the family indicate the meter reading on the card. If the meter is not read correctly, an adjustment is made at the next reading. This system is expected to reduce delinquent water bills.

**Politics and the people's water supply again!** The Columbus, Indiana, *Herald* of January 18 supplies this quotation:

"A number of changes are likely to be made at the water works and possibly the filter plant before the shakeup that is evidently contemplated by Mayor Fred C. Owens has been completed. Today, Wednesday, the employees at the power house are Fred McNeal, superintendent; G. A. Reed, first trick man; Paul Horn, Chris Workinger, second trick men; Tevis Harris and Jesse Brown, third trick men. William C. Smith, former repair man and engineer, is at the present laid off by the mayor. It may be possible that the mayor may conclude to put him back to work, but present indications point to the naming of some other individual at the power plant.

(Continued on page 32)

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## American Water Works Association 59th Annual Convention Atlantic City, June 11-15, 1939

**Housing Headquarters—Ambassador and Chelsea Hotels**

(See map on page 27)

Single Rooms	Ambassador	\$ 3.00 to \$ 6.00
	Chelsea	3.00 to 5.00
Double Rooms	Ambassador	6.00 to 10.00
	Chelsea	5.00 to 8.00
Suites (2 rooms)	Ambassador	12.00 to 20.00
	Chelsea	8.00 to 10.00
Rooms without bath	Chelsea	2.50 to 4.00

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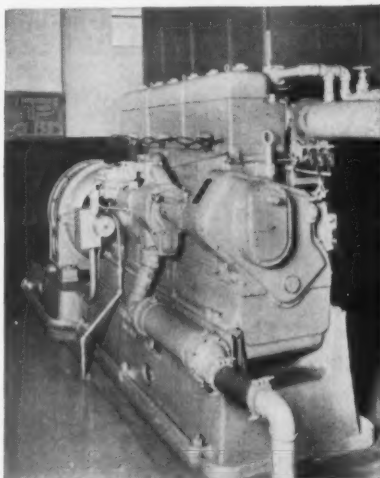
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187 K.V.A. 1200 R.P.M. General Electric Generator direct connected to Sterling Viking 6-cylinder 330 H.P. Engine, for standby service.

Twenty Welland Canal Bridges; The Pennsylvania Railroad; C.R.R. of New Jersey; D.L. & W.; P.L. Bridges at Newark; New York City Triborough Bridge—many of the important lift bridges built in the past 15 years are equipped with Sterling engine generator sets.



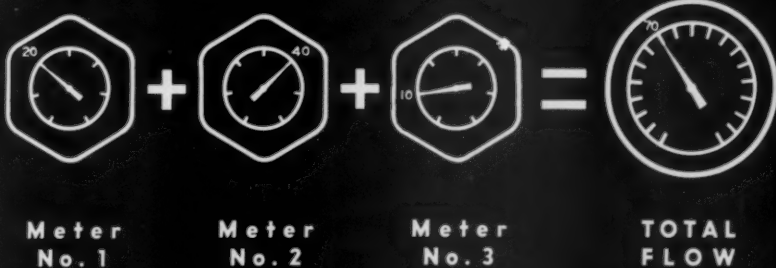
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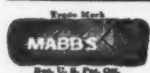
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on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

Why not use it in your plant and benefit thereby?

MABBS HYDRAULIC PACKING COMPANY, Inc. 1892, 431 S. Dearborn St., Chicago, Ill.

(Continued from page 30)

"At the filter plant Ivory Cook, Benton Emich and Charles Davis are the three employees. Cook and Davis are new men and it is barely possible that Emich, who has been at the filter plant for a number of years, will not be changed by Mayor Owens.

"The shakeup at the power plant may or may not be extensive, but it is thought that the changes, if any are made, will be made because of the fact that the workmen failed to guess right and support the right fellow for mayor."

Also, we wonder who the newspaper supported.

Everson Manufacturing Company has issued a publication, No. 1004, to describe its new chlorine metering equipment. Measurement to an accuracy of plus or minus 1 per cent is claimed, and automatic and safety features and a one-valve control are described.

"Lowest water rates in the United States" used to be the boast of Detroit according to an article by Donald Slutz in the *Detroit News* of January 16, 1939. Last September a flat 20 per cent increase in rates was put in effect in Detroit, primarily to meet payments on bonds issued in the 1920's when mains had to be extended in all sections of the city which tripled in area in a period of 11 years. Proposal of a sewage bond issue in the intricate municipal politics now threatens to increase rates outlined as follows by Mr. Slutz:

	RATES IN EFFECT A YEAR AGO	RATES IN EFFECT TODAY	NEW RATES IF BONDS ARE NOT SOLD	NEW RATES IF BONDS ARE SOLD
	Cents	Cents	Cents	Cents
Domestic.....	65	78	92½	97½
Commercial.....	50	60	74½	79½
Industrial.....	40	48	62½	67½

(Continued on page 33)

<div style="transform: rotate(-45deg);">COOK</div> <div style="transform: rotate(-45deg);">Well</div> <div style="transform: rotate(-45deg);">Strainers</div>	{	<p>A reciprocal relation, the life and functioning of the one depending much on the other.</p> <p><b>A. D. COOK, INC.</b></p> <p>Lawrenceburg - Indiana</p>	}	<div style="transform: rotate(45deg);">COOK</div> <div style="transform: rotate(45deg);">Deep-Well</div> <div style="transform: rotate(45deg);">Turbine</div> <div style="transform: rotate(45deg);">Pumps</div>
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(Continued from page 32)

The Alton Water Company, Alton, Illinois, put in operation on January 12, a new water softening plant. The new installation is a lime and soda ash system, two tanks having a capacity of 184,000 gallons each and the clarifier a capacity of 675,000 gallons. Hardness is reduced from about 225 parts per million to about 90. Previous improvements completed include: a new intake and building, and new pumping equipment. The water company buys power from the local power company but also has an independent generator. Pumps which are electrically driven are equipped with two motors, one an alternating current motor to use purchased power and the other a direct current motor to be supplied in emergency by the water company's generator. To make certain that neither coal shortage nor boiler failure interrupts service, the generator at the water plant is powered by a gasoline engine.

Charles Trowbridge, Chief Chemist of the American Water Works and Electric Company, Inc., spent some time testing the water softening plant and working with the plant superintendent, H. S. Molter, to get the plant ready for initial operation.



\*William Chenier (left), employed since 1893. Joseph A. Chenier (right), employed since 1919. Father and son have a total service record of 64 years with the National Meter Company.



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**NATIONAL**

BOSTON CHICAGO DALLAS LOS ANGELES SAN FRANCISCO

*Meters*

(Continued from page viii)

*Reinstatements (Active)*

EBERT, R. E. Chemist, Water Dept., 1368 E. Sprague St., Winston-Salem, N. C.  
 IRELAND, DAN W. City Chemist, Burlington, N. C.  
 SPENCE, W. O. Asst. Filter Plant Operator, Sanford, N. C.  
 SHAW, HARRY B. Deputy Chief Engr., Washington Suburban Sanitary Dist.,  
 Hyattsville, Md.

*Transfers between sections*

ARMSTRONG, JAMES W., from Four States to Florida  
 BATY, J. BERNARD, from New Jersey to Canada  
 CLARK, F. W. G., from Canada to China  
 MALCOLM, WILLIAM LINDSEY, from Canada to New York  
 TOLMAN, S. L., from Ohio to New York  
 WAGNER, RICHARD E., from New York to New Jersey  
 BODISHBAUGH, DON, from Illinois to Indiana  
 KELSO, GILBERT L., from Indiana to W. Virginia

*Resignations*

ADAMS, JOHN M. 1226-3rd Ave., West, Seattle, Wash.  
 BRADLEY, F. B., Gen. Mgr., Eagle & Phenix Mills, Columbus, Ga.  
 CODY, J. P. Illinois Water Service Co., Champaign, Ill.  
 DICK, ROBERT. Sanitary Engineer, 420 Lexington Ave., Room 2412, New  
 York, N. Y.  
 DIXON, LEON S. M.E., Box 300 G. C. Annex, New York, N. Y.  
 DOLAND, JAMES J. Prof. of Civil Engineering, University of Illinois, 317 Engineer-  
 ing Hall, Urbana, Ill.  
 DOW, ALEX. President, The Detroit Edison Co., 2000 Second Ave., Detroit,  
 Michigan.  
 MILLER, A. O. Pres., Petroleum Iron Works Co., Box 539, Sharon, Pa.  
 MORRILL, JOHN E. Asst. Engr., Sewerage & Water Board of N. O., 526 Carondelet  
 Street, New Orleans, La.  
 OLIVER, R. L. Service Engr., Dearborn Chemical Co., 2029 Huntington Lane,  
 Fort Worth, Tex.  
 OVERMAN, R. E. Mayor of City of Little Rock, City Hall, Little Rock, Ark.  
 PENA, ISIDRO R. Instructor in Chemistry, College of Agriculture, Mayaguez,  
 Puerto Rico.  
 PENNEBAKER, H. A. City Manager, Box 216, Tulare, Calif.  
 RAMEY, H. P. Asst. Chf. Engr., Sanitary District of Chicago, 910 S. Michigan  
 Ave., Chicago, Ill.  
 TOWNLEY, D. H. Engr., Elizabethtown Water Co. Consol., 22 W. Jersey St., Eliza-  
 bethtown, N. J.  
 WEBB, VAN G. Mgr., Pittsburgh Testing Laboratory, 816 Howard Ave., Room 494,  
 New Orleans, La.  
 BERNARD CO., INC. S. M. Lemarie, Sales Mgr., 829 Union Street, New Orleans, La.  
 (Corp. M.)  
 MUNICIPAL WATER WORKS. Joe W. Lovell, 129 E. Main St., Murfreesboro, Tenn.  
 (Corp. M.)  
 REMINGTON RAND, INC. H. J. Johnson, Sales Manager, Public Utilities Depart-  
 ment, 465 Washington St., Buffalo, N. Y. (Assoc. M.)  
 REYNOLD MFG. CO. L. L. Keough, Gulf State Bldg. P. O. Box 1048, Dallas, Tex.  
 (Assoc. M.)

*Deaths*

MOLIS, WM. Superintendent, Water Works, Muscatine, Iowa (Hon. M.)  
 ALLEN, R. N. Commissioner of Public Utilities, Shreveport, La.  
 BOOTH, L. M. Pres., Booth Chemical Co., P. O. Box 203, Elizabeth, N. J.  
 DURKEE, GEORGE A. Supt., Water Works, 37 Silver St., Clifton Springs, N. Y.  
 FAST, ALGER. Asst. Mgr., Monterey County Water Works, Lighthouse Ave.,  
 Pacific Grove, Calif.  
 HOLDREDGE, L. I. District State Sanitary Engineer, 27 Ford Ave., Oneonta, N. Y.  
 HOPKINS, CHARLES COMSTOCK. Hydraulic & Sanitary Engr., 349 Cutler Building,  
 Rochester, N. Y.  
 JOHNSON, E. A. Meter Expert, 400 Lexington Ave., Pittsburgh, Pa.

## NEWS OF THE FIELD

"If the wheels of invention were stopped and the processes of discovery were stilled, we should, I am sure, continue to live in comfort."

These were words of William O. Douglas, Chairman of the Securities and Exchange Commission, in an address at Fordham University in New York on February 9. He further said, "Known skills and devices could go on servicing the physical needs of man interminably. They might not be as efficient as scientists could make them. But I have no doubt that the needs and desires of man could be met on the physical side."

This opinion of research and invention is not a new one. Dean Inge of London said about the same thing a few years ago. Copernicus and Galileo, Pasteur and Lister, as well as many other devoted servants of humanity, in their scientific work have met the same defeatist philosophy.

It might be suggested that such an opinion is not a cheering one when held by a man who is in such a strategic position with relation to industrial and financial development in the United States. That, however, is beside the point.

Is the philosophy tenable? That is the real question. Let us examine it in our own field as water works men. Suppose, for example, that the Louisville Water Company had not employed George W. Fuller to investigate rapid sand filtration in 1894. Men were living in comfort. The physical needs of men were being met—in the fashion of the day. But without the study of water treatment methods then made by Fuller and his associates, this country and all the rest of the world besides would have continued to suffer its annual death toll from water-borne diseases and "unclean" would be the term for cities' water supplies.

Suppose that Leal and Johnson and Tiernan and Wallace and all the rest had said, "Filtration is making water safe enough. Why worry about an additional treatment method to sterilize it?" We would still live in comparative comfort—if we lived. But today in the cities of America alone there are 10,000 lives less lost annually because chlorinated drinking water, pasteurized milk and the urban freedom from flies have reduced the possibility of intestinal infection. Today, likewise, New York, Los Angeles, Chicago and every other large city in this country has more dependable water service because the men engaged in the production of pipe, pumps, cement, and all the other accessories of modern water supply have improved equipment.

Yet today we still search for methods to reduce corrosion, to make metals stronger, to make materials last longer. Shall we stop the search because we live in comparative comfort?

(Continued on page 2)

(Continued from page 1)

The answer—a categorical negative—goes deeper than a mere rejoinder to Douglas or Inge or any other temporary prophet of defeat. The quality that differentiates human life from the highest type of animal life is that ceaseless upward urge for better things. The striking characteristic of civilization is that it breeds intelligent discontent with things as they are.

The automobile, the telephone, the electric service industry, as well as the fields of rubber, plastics, pharmaceuticals, along with others any of us can name, all agree with the water works industry in the idea that the stopping of invention would be a worse disaster than all the wars that men have fought. For if humanity ends its search for improvement and its urge for discovery it loses the very quality that makes it human and civilized and worth while.

---

Arthur H. Miller, director representing the Wisconsin Section of the A. W. W. A. and superintendent of water supply at Sheboygan, Wisconsin, died March 2 in Sheboygan. Mr. Miller was chairman of the Wisconsin Section in 1935 before serving as director. He graduated from the University of Wisconsin in 1905 and following his graduation taught at the University for seven years. He had served in a supervising capacity in the metal working industries in Sheboygan before becoming water commissioner in 1926. He became superintendent in 1931.

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Calling public relations the “No. 1 topic of conversation” among business men, Paul Garrett, Director of Public Relations for General Motors Corp., speaking before the McGraw-Hill Public Relations Forum in New York City, called attention first to the recent trend toward giving frank information to employees, a practice which he favors.

Mr. Garrett then developing the tenet that industry must be community-conscious said, “The background of good community relations lies in the things done to foster the town’s welfare. Local plant managers must become civic minded if they are to retain local good will; they must assume their share of community responsibility. If the plant wishes to be considered a good neighbor in the community it must *be* one.”

The third point developed was that industry and its plants must become better acquainted with the many related businesses and communities that supply parts or raw materials. Fourth in the address was the idea of the great importance of the consumer as the common denominator in public relations. Mr. Garrett said:

“Possessor of the highest standard of living in the world, enjoying conveniences and luxuries to an extent hardly dreamed of elsewhere, the

(Continued on page 4)

# A PIPE WITH THREE LIVES...

**1901** The story begins with the installation of a 48-inch cast iron water main under North Broad Street, Philadelphia, in 1901. After 24 years of service, the construction of the Broad Street Subway required its removal. The pipe was salvaged, reconditioned and placed on sale for service not requiring A. W. W. A. wall thickness.

**1925** It is shipped by boat from Philadelphia to Los Angeles, 4866 nautical miles away, bought for the City of Glendale, California, to be used for an intercepting sewer river crossing under the Los Angeles River. It was unloaded at Los Angeles for delivery to the job at Glendale, where it was laid for the *second time*. Sold at a saving over the cost of new pipe yet having realized a good salvage value for Philadelphia, both cities benefited.

**1938** Thirteen years later a Flood Control program required deepening the Los Angeles River channel, involving relocation of the Glendale intercepting sewer. It was found economical to uncover this 48-inch cast iron line and remove it for reinstallation. Last year this pipe started out on its *third life*, after 24 years of service at Philadelphia and 13 years of service in its first location at Glendale. Barring unforeseen circumstances, this cast iron pipe line will serve for a century or more in its present location.

THIS STORY of the adventures of a 48-inch pipe line is a striking example of the salvage value of cast iron pipe. The recognized standard material for underground mains, cast iron pipe is also unequalled for long life and low maintenance cost, justifying its reputation as Public Tax Saver No. 1.



Look for the "Q-Check" registered trade mark.  
Cast iron pipe is made in diameters from 1½ to 84 inches.

The Cast Iron Pipe Research Association, Thos. F. Wolfe Research Engineer, 1015 Peoples Gas Building, Chicago

# CAST IRON PIPE

## PUBLIC TAX SAVER NO. 1

(Continued from page 2)

American consumer is in the final analysis both the creator and the beneficiary of our system of industrial enterprise. In customer relations, as elsewhere, industry must interpret itself in terms of those it benefits. There is a vital and dramatic story, for instance, in the vast new values created by industry during the depression decade since 1929. New products, better products, new adaptations of old materials, better methods of distribution—in all these directions industry has moved far ahead to the benefit of the customer at the very time some people have accused industry of holding back recovery. . . .

"Previously, purely economic consideration too often determined success. Now it becomes apparent that social considerations in industry will set the pace to success. And it will be through a greater degree of social-mindedness that industry can best expand its opportunities to serve people and to pay stockholder profits. Perhaps I should say that it is through its better understanding of these social responsibilities that industry must find its future for, if not through industry, how else can the insistent demands of people be satisfied?"

(Continued on page 6)



**SHAKE WELL  
BEFORE USING!**  
*doesn't apply to this  
Better Jointing  
Compound*

Properly mixed at our plant, the solid ingot form cannot change composition en route to you. With Tegul-MINERALEAD there can be no settling of heavier particles to upset the value of the compound • The 10 lb. ingot is also easy to handle, ship and store. Impervious to rain, snow and flood, it may be stored outdoors on the job • Tegul-MINERALEAD means quick-sealing, permanently tight joints. Initial leakage heals so quickly that trenches can be backfilled and premises cleared up almost immediately • For further information, write The ATLAS MINERAL Products Company of Penna., Mertztown, Pennsylvania.

**Tegul-**  
**MINERALEAD**



## For Underground Service Lines

### ANACONDA COPPER and RED-BRASS



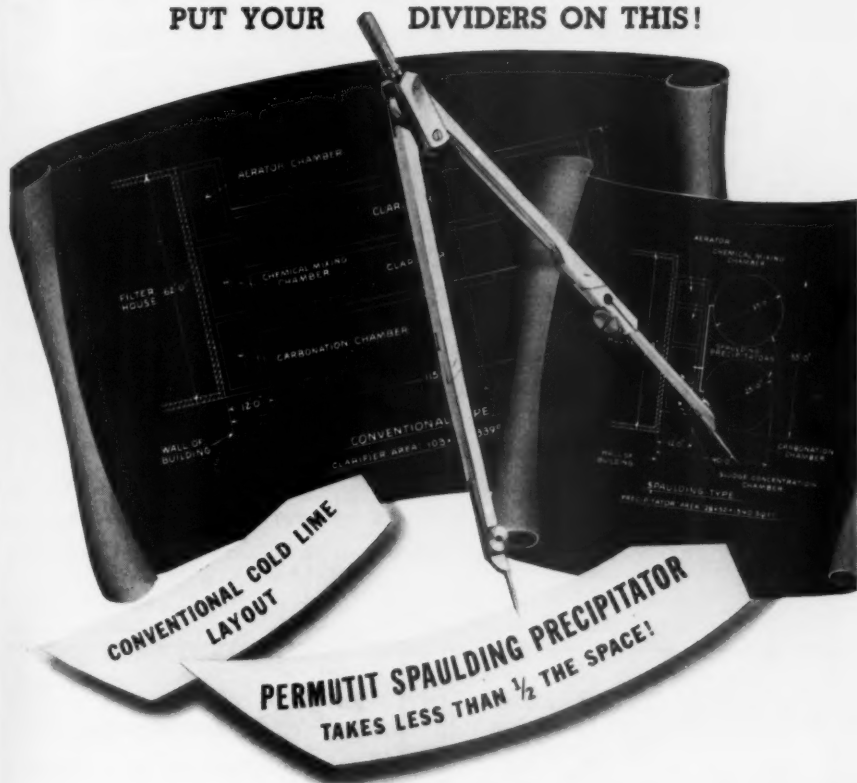
Anaconda Copper Tubes in straight lengths and coils... Anaconda "85" Red-Brass in straight lengths only — both are products of dependable quality. Made by the world's largest and most experienced manufacturer of copper and brass, and stocked by leading supply houses.

3924

**THE AMERICAN BRASS CO.**  
General Offices: Waterbury, Connecticut

# New Cold Lime Treatment...

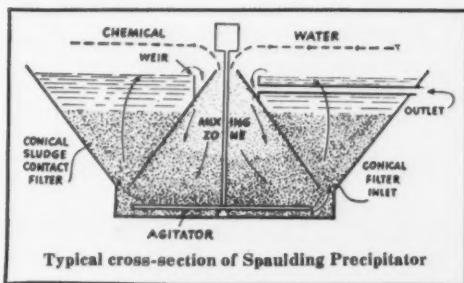
PUT YOUR DIVIDERS ON THIS!



**L**ESS than half the space! Substantial savings in chemicals! A clearer effluent than ever before! When you get all these advantages at once... that's big news!

And that's just what you get with Permutit's new Spaulding Precipitator. New, revolutionary principles are used: Sludge, for instance, is not permitted to settle. It's kept in constant suspension by means of an agitator (see diagram). A good portion of old sludge is always retained in the Precipitator. This mixes with the newly forming sludge, acts as a contact filter. The conical shape of the chamber lowers the velocity of the water as it rises. Then sludge drops out, leaves effluent clear and sparkling.

Write for booklet. Also booklets on Permutit Zeolite Water Softeners, Iron Removal Plants, and other automatic accessory equipment. The Permutit Company, Dept. G2, 330 West 42nd Street, N. Y.



**PERMUTIT** THE WATER CONDITIONING HEADQUARTERS **OVER 25 YEARS**

(Continued from page 4)

"Doctor Jones," who writes a column of this and that in *Health News*, a publication of the New York State Department of Health, some time ago attributed the honor of having "the first municipal public health laboratory in the world" to New York City in 1892. Doctor Jones was corrected by someone who quoted from a book called "A Half Century of Public Health" which gave Providence precedence as of the year 1888.

This leads to questions concerning the "first" laboratory established as a part of a water purification system. The Massachusetts State Experimental Station at Lawrence carried on tests for the municipal filter plant from its beginning in 1893. The Mount Prospect laboratory of the Department of Water Supply of New York City was established in 1897, but it was a laboratory of record only and not until many years later one for control of treatment. What filtration plant in America was the first to install its own laboratory and add a chemist or bacteriologist to its staff?

Foreclosure on the water works of Mason, Ohio, is sought by the Phillipsburg State Bank which wants a receiver appointed in order to protect the \$31,500 in mortgage bonds. The bank says that the fore-

(Continued on page 8)



— • —  
An electrical appliance which eliminates Rusting, Corrosion, Pitting and Painting below the water line in Steel Water Tanks.

— • —  
Costs about as much as a coat of paint to own, and less than 50¢ a month to operate.

— • —  
*Send for Bulletin 55,  
A fine explanation of Rusting*  
**RUSTA RESTOR CORPORATION  
FREMONT, OHIO**

**O**VER 500 municipalities use American or New York Continental Jewell Water purification equipment.

## WATER FILTERS WATER SOFTENERS

Proportionate Electro-Magnetic Chemical feeders for feeding lime, acid, alum, soda ash, etc.

## AMERICAN WATER SOFTENER COMPANY

Lehigh Avenue and 4th St.  
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## **WORTHINGTON EQUIPMENT FOR WATER SUPPLY**

**CENTRIFUGAL PUMPS**

**STEAM AND POWER PUMPS**

**DEEP WELL TURBINE PUMPS**

**SUMP AND DRAINAGE PUMPS**

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**REDUCING AND INCREASING GEARS**



### **WATER METERS**

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

**WORTHINGTON PUMP AND MACHINERY CORPORATION  
WORTHINGTON-GAMON METER COMPANY**

General Offices: **HARRISON, NEW JERSEY** District Offices and Representatives in Principal Cities

(Continued from page 6)

closure action is necessary to conserve the assets of the municipal water works because, as the plaintiff charges, the village has used revenue derived from the operation of the plant for other than the reasonable expenses of operating the system. This action, the Phillipsburg Bank contends, has been detrimental to the bondholders.

**R. Norman Baxter**, owner of the water works system of Manchester in Adams County, Ohio, has asked the state utilities commission to allow him to abandon fire protection and supplying of water for public service. He declared that, since the water works was established in 1928, the village had paid only \$3,660, or one year's contract price, for the public service and had accumulated a debt of \$34,360.

**"Art" Carr**, Chairman of the New Jersey Section and for twenty-five years superintendent of the water department of Ridgewood, New Jersey, was an unprepared guest at a dinner at the Elk's Club in his home town on March 15. Local citizens, members of the New Jersey Section of the A.W.W.A., and friends from many points joined in a testimonial

(Continued on page 12)

## WHITE FILTER SAND

98% Pure Silica



Washed, Screened and Dried.  
No Freight on Moisture—  
Prompt shipment in Bags or  
paper lined Box Cars—Write  
or wire us for information and  
prices.

**DAWES SILICA MINING  
COMPANY**  
*Silica Mines*  
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## EDSON DIAPHRAGM PUMPS

**Hand Operated**—size 2", 2½", 3", 4"

**Power Operated**—size 3" and 4"

**Open Discharge or Force Pump  
Skid, Truck or Trailer Mounted**

**Complete Pump Outfits, Genuine  
Edson Pumps, Suction Hose,  
Brass Couplings, Bronze Clamps,  
Red Seal Diaphragms,  
Brass Strainer or Foot Valve,  
Hose Spanners, Adapters, Etc.  
Standard Hydrant Protector,  
Brass Hydrant Pump.**

### THE EDSON CORPORATION

Main Office and Works: 49 D St.,  
South Boston, Mass.

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# THE ANSWER TO A PROBLEM

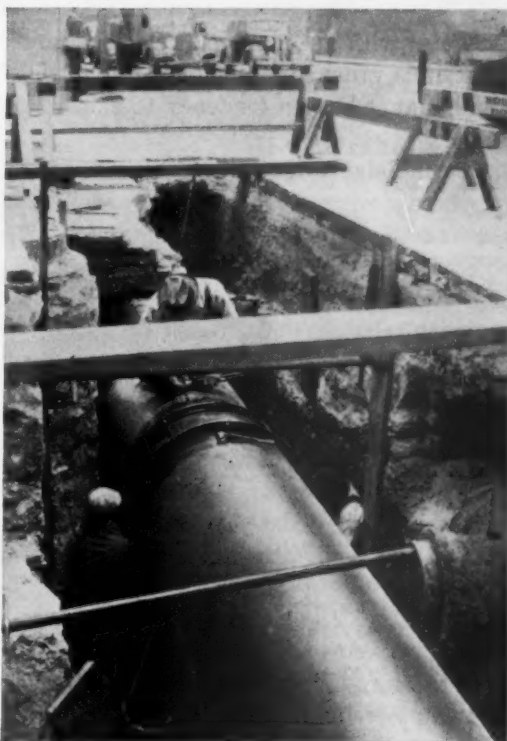
# ALCO PIPE

FOR

# C H I C A G O

Cities using  
ALCO STEEL PIPE  
include the  
following:

Auburn, N. Y.  
Birmingham, Ala.  
Buffalo, N. Y.  
Chicago, Ill.  
Cincinnati, Ohio  
Clarksburg, W. Va.  
Cleveland, Ohio  
Denver, Colo.  
Detroit, Mich.  
Fairport, Ohio  
Fort Wayne, Ind.  
Elizabeth, N. J.  
Hartford, Conn.  
Manitowoc, Wis.  
New York, N. Y.  
Niagara Falls, N. Y.  
New Brunswick, N. J.  
Ogden, Utah  
Philadelphia, Pa.  
Salamanca, N. Y.  
Washington, D. C.  
Wilmette, Ill.



The Water Department of Chicago and the Chicago Union Station were jointly and seriously concerned about the material to use in the 36" line to replace pipe running under the tracks of the station. The answer, illustrated above, is Alco Electric Welded Steel Pipe. No further need to worry about disastrous breaks.

## ALCO FEATURES

Greater Strength  
Longer Life  
Smoother Waterway  
Longer Lengths  
Fewer Field Joints  
Low Initial Cost  
Ultimate Economy

Alco Electric Welded Steel Pipe is supplied in diameters from 18" to 120"

## ALCO PRODUCTS DIVISION

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Plants at Dunkirk, N. Y., and Montreal, Canada

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AMERICAN LOCOMOTIVE COMPANY

## New Materials and Gadgets

1. **An Aluminum Paint** with an improved vehicle is now on the market with the claims that it is pre-mixed and does not settle, that it retains gloss indefinitely and that it has no tendency to skin in the container.

2. **A Thermostatic Air Valve** to go on the radiator in a one-pipe steam heating system has been designed for individual room temperature control. The unit can be set for temperatures ranging from 60 to 80 degrees.

3. **Electric Lunch Boxes** have been developed for employers who are seeking better employee relations. At a cost of about 1 cent, a meal is heated in 15 minutes. Cold foods in the lower compartment are insulated from the heating unit.

4. **Colored Concrete Floors** for use where heavy traffic causes frequent repainting can now be laid by what is called a comparatively simple technique. A fine dry powder of intense dyeing power is added to the concrete, giving it uniform pigmentation throughout the mix in any of eleven colors.

5. **A Shin Guard** for workers subject to shin hazards has been designed to fit the contour of the leg. It is made of fiber with horizontal ribs for strength and sponge rubber for packing, and can be worn either inside or outside the clothing.

6. **A Flexible Hose** for oil connections is made of a metal core covered with cellulose laminations. Outside is a synthetic rubber cover which is protected by a metal braid to prevent elongations under pressure.

7. **A Sound Muffler** designed for installation at any point in the intake or exhaust system of an engine or compressor is claimed to eliminate both the sharp reports and the rumbling sounds.

8. **Two People** can hear from the same telephone receiver by means of a new attachment which resembles a stethoscope. It is useful for a stenographer or a witness to a call.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items and citing the March issue as the source.

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**FREE**—Complete, illustrated catalogue on "Century" Asbestos-Cement Pressure Pipe. Covers every phase of the subject, answering all your questions in detail. This book may help to save you thousands of dollars in pipe maintenance, in replacements, and in pumping cost.



# New...

## "MAINS WITHOUT MAINTENANCE"

Get all the remarkable facts on "Century" Asbestos-Cement Pipe

One of the outstanding developments of recent years has been Asbestos-Cement pressure pipe . . . the answer to many of the most difficult problems formerly met in the distribution of water throughout a community. It has reduced pumping costs, cut maintenance, and ended tuberculation, corrosion and electrolysis.

Now, The Keasbey & Mattison Company, pioneers in asbestos products, announce "Century" Asbestos-Cement Pipe, made by a remarkable new process that produces a superior, tough, rugged pipe of high and uniform strength. Each length is subjected to a hydrostatic test of twice its normal working pressure.

It is light in weight for easy handling (8", Class 100 pipe, for example, weighs less than 13 lb. per linear foot), has a permanently smooth bore that cuts pumping costs (Williams and Hazen Constant of "C" 140), and never needs relining, or cleaning due to tuberculation or corrosion. It is of exceptionally long service life. "Century" Flexible Couplings provide permanently tight joints.

### KEASBEY & MATTISON COMPANY

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District Sales Offices in Principal Cities

MAIL THIS  
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Send me, without obligation, free catalogue on "Century" Asbestos-Cement Pressure Pipe—"Mains Without Maintenance."

NAME \_\_\_\_\_

NAME OF PLANT \_\_\_\_\_

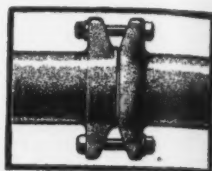
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# UNIVERSAL CAST IRON PIPE

LAID WITH JUST WRENCHES



No other tools are needed. No lead, no pouring, no bell holes to dig. Machined iron-to-iron flexible joints. **SPEEDIEST...EASIEST...SAFEST.** Highest quality Cast Iron.



## THE CENTRAL FOUNDRY COMPANY

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CHICAGO, ILL., 1105 W. 36th St. - OAKLAND, CALIF., 278 Fourth St.  
OFFICES IN PRINCIPAL CITIES COAST TO COAST

(Continued from page 8)

dinner in his honor. Reeves Newsom and Bill Orchard were among those who spoke in praise of Carr as a leader among water works men and a fine executive of a city's water plant.

Springfield, Ohio, has received plans for its new filter plant which will have eight units with a total capacity of 24,000,000 gallons per day. Estimated cost of the plant is \$665,860. It will have two wings of 160 feet extending from the main structure which will have a center tower rising 60 feet high. Alvord, Burdick and Howson, Chicago engineering firm, drew up the plans.

The American Society of Mechanical Engineers has just published two new A. S. A. standards, one covering cast-iron pipe flanges and flanged fittings for maximum saturated steam service pressures of 125 lb. per sq.in., and the other covering steel pipe flanges and flanged fittings.

The Standard on cast-iron pipe flanges is a revision of the 1928 edition. Corrections have been made in wall thicknesses on sizes 3-inch and smaller in order to establish the actual minimum dimensions that have

(Continued on page 14)

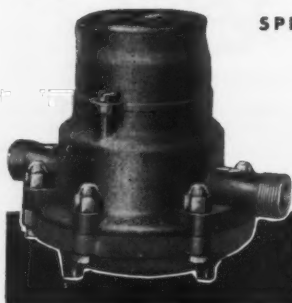
## FIRST QUALITY METERS EXCLUSIVELY

SPECIFY

*American or Niagara*  
(BRONZE CASE) (IRON CASE)

*Water Meters*

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**BUFFALO METER COMPANY**

Established 1892

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# DE LAVAL FOR INSURANCE PUMPS

Three De Laval general service pumps supplying a great industrial plant; capacities 7600 g.p.m. against 54.5 ft.; 12,000 g.p.m. against 56 ft.; and 19,000 g.p.m. against 60 ft., respectively.



A \$5,000,000 plant, using water in large quantities and operating 24 hours per day the year around, depends for its water supply upon the three De Laval pumps shown in the photograph, continuous operation being provided by connections to a reservoir and to a city water works system.

De Laval pumps are designed with particular regard to reliability in service, viz:

1. The casings are split horizontally in the plane of the axis, so that internal parts are readily accessible and renewable without disturbing piping.
2. Labyrinth wearing rings, which protect casing and impeller and restrict leakage from discharge to suction, give longer life and sustain efficiency over longer periods than do flat wearing surfaces.
3. Parts subject to wear, such as bearings, shaft sleeves, casing bushings, and wearing rings, are made to limit gages on an interchangeable basis, so that renewals do not require to be fitted and can be inserted quickly.
4. De Laval pumps are guaranteed as to efficiency and other characteristics and are tested before shipment from our works.

State your  
requirements  
so that we  
may send data  
and literature.

3205

## DE LAVAL *Steam Turbine Co.* TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES, PUMPS—CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, CENTRIFUGAL BLOWERS AND COMPRESSORS; WORM GEARS, HELICAL GEARS; HYDRAULIC TURBINES AND FLEXIBLE COUPLINGS... SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM

(Continued from page 12)

been in use with cast iron. Wall thickness tolerances have been included and steam service pressure ratings revised. Single copies of the Standard are priced at 60 cents, quantities being available at somewhat reduced rates.

The Standard for steel pipe flanges is a revision of the 1932 edition and has numerous additions and changes including the following: tables of dimensions for 2,500-pound series of steel pipe flanges and fittings; dimensions of welding neck flanges and fittings for all pressures; details of welding bevel for all welding neck flanges for 150- and 300-pound pressures; dimensions for slip-on welding flanges for 150- and 300-pound pressures; dimensions for blind flanges for all pressures; bolt lengths for flanges of all pressures, types and sizes; detailed dimensions for ring joints designed for 150- to 2,500-pound pressures; revised and extended temperature-pressure ratings; and dimensions of reducing screwed flanges for pressures of 150 to 2,500 lb. Single copies of this Standard are available at \$1.25 each, with somewhat reduced rates for quantities, from the American Society of Mechanical Engineers, 29 West 39th St., New York City.

(Continued on page 16)

## Why your community should have SAFETOPS



MINIMUM pressure loss provided by extra large standpipe and smooth easy elbow and nozzle curves.

Maximum reliability assured by simple, straight-line operating mechanism and special long-wearing valve and gasket materials.

Minimum repair expense secured by the unique Safety Breakable Section. When struck by an impact which no hydrant could resist, this section parts cleanly, protecting the major and expensive portions of the hydrant from damage. The hydrant can be returned to service by one man, within half an hour, without excavating or shutting off the water pressure, and with parts costing only \$6.00.

Maximum convenience obtained by ease of adjustment of working parts, nozzle positions, lubrication, etc.

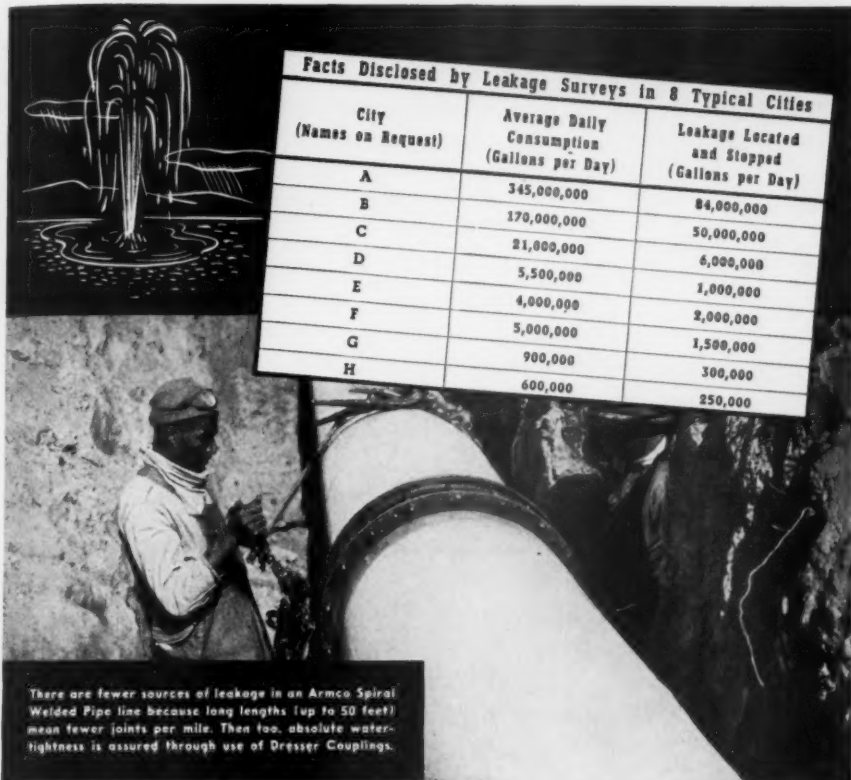
*Write for descriptive bulletin*

The Kennedy Valve Mfg. Co., Elmira, N. Y.

**KENNEDY**  
**SAFETOP**  
REG. U.S. PAT. OFF.  
**FIRE HYDRANT**

# AVOID THIS WASTE

## IN NEW SUPPLY LINES AND FORCE MAINS



Every gallon of water you lose through broken, leaky pipe means a loss in revenue. In hundreds of cities (like those shown above) surveys have disclosed water losses ranging up to 25% of daily consumption. Besides, in many of these cities the annual cost of repairing joint leaks and breaks has jumped to more than \$100 per mile of main—with-

out considering damage to property.

Fortunately you can avoid this trouble and expense by using Armco Spiral Welded Steel Pipe. It eliminates "sudden breaks." Even more, it assures a watertight line that will remain free of joint leakage. Write for the complete story. The American Rolling Mill Co., Pipe Sales Div., 590 Curtis St., Middletown, Ohio.

**ARMCO**



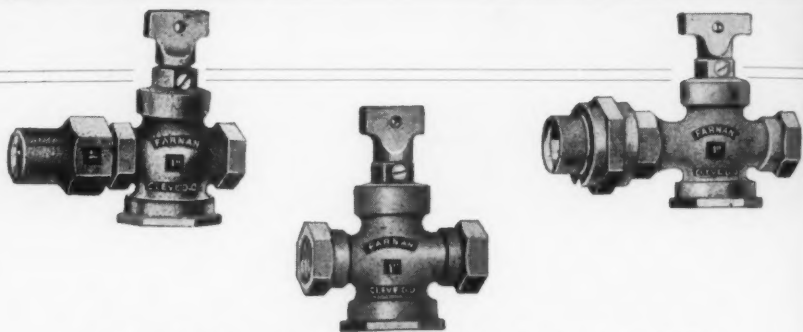
**SPIRAL WELDED PIPE**

(Continued from page 14)

**Laurence G. Lenhardt**, General Manager, Detroit Department of Water Supply, has instituted a course called "Water Purification and Sewage Treatment" at the School of Public Affairs and Social Work, Wayne University, Detroit. The course has proven so popular that a total registration of 81 students has been divided into two classes with identical meetings and lectures twice weekly for a 16-week period. Phases of water purification covered include: history and development, types of water purification, additional treatment, laboratory control, and in particular the methods employed at Detroit. In conjunction with this last phase, classes are held at the water department's Springwells plant.

**Bulletins on lawn care** issued by O. M. Scott and Sons Company of Marysville, Ohio, contain valuable information which many water departments may wish to pass on to consumers. With spring approaching, information from these bulletins may help water works men to be forehanded in improving consumer relations at sprinkling time. Send your name to the Scott Company if you would like to receive the bulletins.

(Continued on page 18)



## FARNAN CLEVELAND

**TWO WORDS—FARNAN CLEVELAND**—these are all you need to remember to insure your obtaining the highest grade brass stops, couplings and fittings that can be purchased at any price anywhere. **Quality Plus, and Durability Plus, mean Economy Plus.**

**THE FARNAN BRASS WORKS CO.**  
**CLEVELAND**      *ESTABLISHED 1852*      **OHIO**

# Dangerous Waters!



WHEN floods bring the threat of polluted water supplies and of water-borne disease, HTH proves itself an invaluable ally to water works and health officials. With HTH, emergency hypochlorination can be applied quickly, on the spot, wherever pollution is found. A highly concentrated chlorine carrier, containing 70% of available chlorine, quickly soluble in water, HTH can be transported to the job and put to work before a dangerous situation has time to develop.

Then there is the aftermath of flood conditions, as receding waters leave a seemingly hopeless task of cleaning up and disinfecting flooded areas and buildings of every kind. Here again health authorities find HTH of invaluable assistance in restoring sanitary conditions in scores of places where a less concentrated, less mobile or less soluble

source of chlorine cannot serve as effectively.

Fortunately, floods do not strike frequently at the average community nor do they strike so quickly as to find local officials wholly unprepared. But there are day-to-day emergencies, too, which require prompt and effective chlorination—broken water mains, an abnormal water load due to a serious fire, polluted wells, failure of a chlorinator, an interruption in the power supply—just the sort of jobs for which HTH is made to order.

No wonder that so many experienced water works men keep an ample supply of HTH always on hand, not only as an important measure of preparedness for every sort of emergency, but also because they find it so useful in scores of every-day sanitation jobs! Write or wire us for full information and nearest available stock.

**The MATHIESON ALKALI WORKS (Inc.) 60 East 42nd St., New York, N. Y.**

Liquid Chlorine . . . HTH and HTH-15 . . . Soda Ash . . . Caustic Soda . . . Bleaching Powder . . . Bicarbonate of Soda  
Ammonia, Anhydrous and Aqueous . . . FR-Plus (Fused Alkali) . . . Solid Carbon Dioxide

**BE PREPARED WITH HTH FOR ANY EMERGENCY!**

(Continued from page 16)

**Reporting on water pollution**, the National Resources Committee in its report to President Roosevelt in February recommended a federal policy providing technical and financial aid to states for pollution abatement. The report emphasized that responsibility for pollution abatement is primarily local, but that financial considerations have been a major obstacle to abatement activities. The report said that more progress has been made in municipal pollution abatement in the U. S. during the past six years than in the preceding 25 years and that these advances have resulted principally from financial inducements afforded by the emergency work relief and public works programs.

Recommendations were: (1) that an appropriate federal agency, presumably the U. S. Public Health Service, be authorized to study water pollution, to stimulate state, municipal and private study, and to co-operate with states in securing state legislation and interstate action; (2) that federal assistance be given in the form of grants and loans to public bodies and in the form of loans to industry; (3) that recommendations of such aid should come from the above mentioned federal agency; (4) that appropriations be administered by an appropriate federal public

(Continued on page 20)

**28**  
APR. '38

**41**  
OCT. '38

**56**  
JANUARY '39

## More and More ACCELATORS

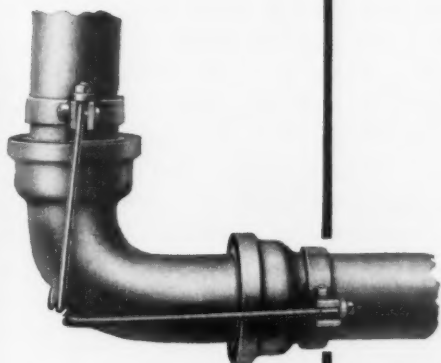
- More and more users are finding the Accelator to be the outstanding water treating process for softening, clarifying and stabilizing. In April, 1938, there were 28 Accelators in service or under construction. By October, 41, and by January, 56!
- This wide and enthusiastic acceptance is based upon *operating results*. Accelators are *proving* their superiority by *actual performance*.

• Bulletin 1820 describes the Accelator, and points out its advantages. Let us send you a copy. Write today.



**INTERNATIONAL FILTER CO.**

59 E. Van Buren St., Chicago, Ill.



## Easier to use

The compact design of Grinnell Socket Fittings reduces the size and weight of fittings . . . lessens friction losses.

Savings in installation time and lower materials cost are direct results obtained through this improved design. Connections—even in the most limited spaces are easily accomplished with Grinnell Socket Fittings. Grinnell Company, Inc., Executive Offices, Providence, R. I., Branch offices in principal cities.

**SOCKET FITTINGS  
BY**

# GRINNELL

...WHENEVER PIPING IS INVOLVED...



(Continued from page 18)

works agency; (5) that all such programs be cleared through a federal coordinating agency to insure conformity to regional plans; and (6) that Congressional consent be given to negotiation of interstate pollution-abatement compacts.

Estimated costs of an adequate program that would require ten to twenty years for completion are as follows: (1) to treat municipal sewage—a capital cost of approximately \$1,000,000,000; (2) to complete sealing of bituminous coal mines—a cost of approximately \$12,000,000; to control anthracite waste—a capital cost of approximately \$40,000,000; to carry out a minimum program of treatment of oil field brine—a cost of not less than \$100,000,000; (3) to treat industrial wastes, in those instances where practicable processes are known—a capital cost of not more than \$900,000,000.

A compact is already in force between New York and New Jersey to abate pollution of their coastal waters while other compacts in varying stages are those for pollution abatement in the Ohio, Potomac and Delaware Basins.

(Continued on page 22)

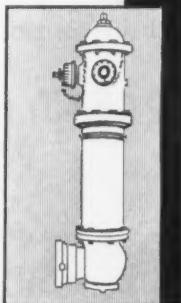
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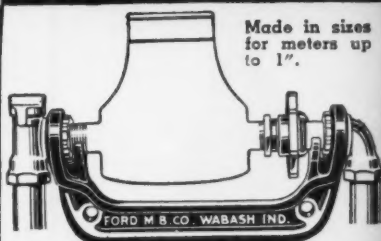
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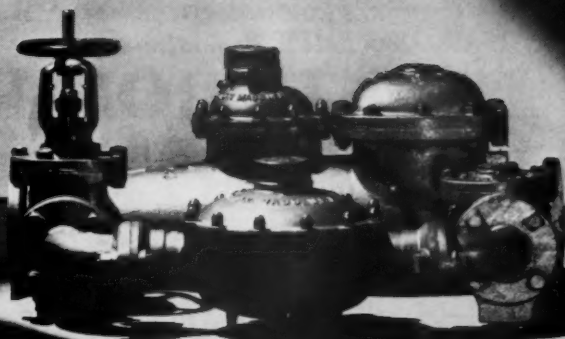
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*(Continued from page 20)*

**Silica in water** is the subject of a 46-page pamphlet by M. C. Schwartz of Louisiana State University, University, Louisiana. Following a brief section on the colorimetric determination of silica, the bulletin is devoted to a comprehensive bibliography with abstracts arranged chronologically, and with an author index. Price of the bulletin is 50 cents, and it is available upon application to the university.

**WPA loans and grants** loom as large factors in construction expenditures according to a survey made by the F. W. Dodge Corporation which is a nationally recognized statistical service in the construction field. The report cites 1938 as the fifth consecutive year of increased construction volume, there being a total of \$3,196,928,000 for 37 eastern states in 1938 as compared with \$1,255,708,000 in 1933.

The report further says, "Publicly financed construction accounted for 53 per cent of the 1938 contract total. It represented 92 per cent of the dollar total of heavy engineering contracts; 53 per cent of the non-residential building contracts; and 9 per cent of residential building contracts. During the past five recovery years, construction expenditures

*(Continued on page 26)*

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*(Continued from page 22)*

have been divided practically on a 50-50 basis as between public and private work."

**Louis A. Geupel** has been appointed water works superintendent at Evansville, Indiana. Mr. Geupel will succeed Charles Streithof who has been in poor health but will remain with the water department as a consultant. Mr. Geupel's former position as city engineer will be filled by Charles Day who has been assistant city engineer.

**Diversion of water funds** to relief purposes has been the purpose of proposed state legislation in Ohio. City Manager John N. Edy of Toledo has come out strongly against it, calling such legislation "perfectly silly." City Manager Edy maintained that all the water department money has been pledged formally to finance the lake water project and that to divert any part of this water works fund to city relief was entirely out of the question.

**Children went back to school** after an unexpected holiday in Zanes-

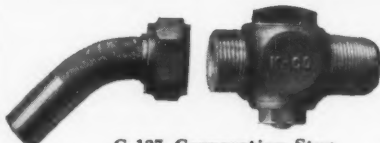
*(Continued on page 32)*

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SAY  
"K-CO"**

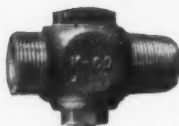
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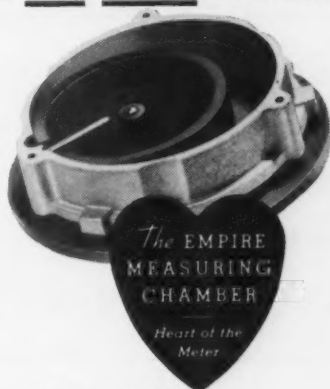
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(Continued from page viii)

- SMITH, IVAN M. K. Supt. of Plant, Borough of Chatham, N. J., 11 Western Ave., Chatham, N. J.  
STEPHENS, CHARLES H. Asst. Civil Engr., Dept. of Water, 79 W. Norman Ave., Dayton, Ohio.  
STEWART, M. T. Mgr., Rockwood Water Co., 768 Grandview Ave., Rockwood, Pa.  
TROUT, CLARENCE L. Gen. Foreman, Harrison Elec. & Water Co., 323 Plum St., Cincinnati, Ohio.  
VAN WERT, JR., FRED. Supt. of Distribution, Borough of Chatham, N. J., So. Boulevard, Chatham, N. J.  
VODEN, STEWART. Water Plant Operator, Great Falls, Montana, Water Works 1405 7th Ave. So., Great Falls, Mont.

#### Corporate

- CITY WATER COMPANY. Mr. William Insull, Vice Pres., 109 North Main Street, Bowling Green, Ohio.  
WATER DEPT. City of El Paso, Texas. P.O. Box 511, El Paso, Tex.  
BOARD OF PUBLIC UTILITIES. Water Division, Mr. Clayton O. Johnson, Supt., Jamestown, N. Y.  
PARKER LABORATORIES. Dr. Francis L. Parker, Ph.D., M.D., Consulting Chemist, 40 Broad St., Charleston, S. C.

#### Associate

- COLUMBIA ALKALI CORP. Mr. A. E. Boss, Technical Service Dept., Barberton, Ohio.

#### Junior

- LESTER, JOHN. Chemist, Morgantown Water Co., 145 Dorsey Ave., Morgantown, W. Va.

(Continued on page 30)

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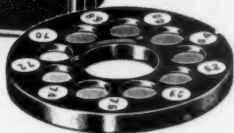
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(Continued from page 28)

*Affiliate*

PICARD, ARMAND. Jr. Civil Eng. Draftsman, Detroit Water Supply, 2940 W. Chicago Blvd., Detroit, Mich.

*Reinstatements (Active)*

ANTWEILER, JOHN J., Asst. Engr. of Distribution, Cleveland Div. of Water, 9013 Empire Ave., Cleveland, Ohio.  
 CHAMBLEE, J. V. Supt., Public Utilities, Selma, N. C.  
 HOYT, EARLE S. Civil & San Engr., 568 East Broad St., Columbus, Ohio.  
 ROBLES, GONZALO. Ing., Banco Nacional Hipotecario Urbano y de Obras Publicas, S. A., Av. FCO. I. Madero No. 32, Mexico, D. F., Mexico.  
 SMITH, W. AUSTIN. Cons. Engr., P.O. Box 1048, Jacksonville, Fla.  
 SNYDER, ROBERT F. Mgr., Toms River Water Co., 29 Snyder Ave., Toms River, N. J.  
 STRICKLAND, G. HUDSON. Supt. of Filtration Plant, Windsor Utilities Comm., Canada Bldg., Windsor, Ont., Canada.  
 VAN CAMP, PAUL M. Civil Engr., Southern Pines, N. C.

*Deaths (Active)*

BURT, AUSTIN. Supt., Water Dept., Ontario, Calif.  
 LEWIS, ALVIN M. Asst. Supt., 323 County City Bldg., Seattle, Wash.  
 THEARD, ALFRED F. Gen. Supt. & Chief Engr., Sewerage & Water Board of New Orleans, 526 Carondelet St., New Orleans, La.  
 WHITE, HENRY M. Supt. of Water Works, Oneida, N. Y.

(Continued on page 34)

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*It's there—even tho' you can't see it!*

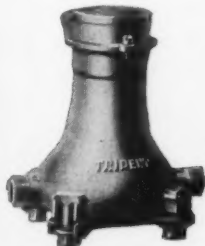


IRON AT IMPACT

*Photo by Edgerton, Germeshausen & Grier, Mass. Inst. of Tech.*

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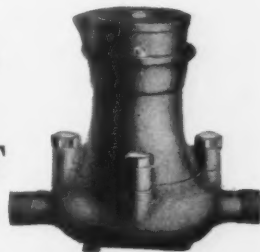
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# Activated Alum Corp.

**CURTIS BAY**

**BALTIMORE, MARYLAND**

*(Continued from page 26)*

ville, Ohio, where water works men had been working overtime to repair a 16-inch high pressure main. There was an insufficient supply for hospitals, and all schools were closed. A broken valve was blamed by Service Director A. S. Herzer. An intensive investigation is now planned because this break and the youngsters' enforced holiday followed hard upon another major break in the city's distribution system.

Purchase of home water softeners by the village of Barrington, Illinois, is now being considered there. Under the proposition, water softening tanks will be bought by the village for \$17 each, to be installed in homes on a direct sale or time rental basis. There will be a \$5 charge for installation of the equipment and a monthly service charge of 50 cents to cover cost of recharging the tanks. The proposed tanks have a capacity of 800 gallons, which, it is estimated, will be the monthly average amount used by a family. This amount is for hot water only, it being pointed out that the tank is to be installed alongside the water heater in the home to remove hardness only from the water that is to be heated.

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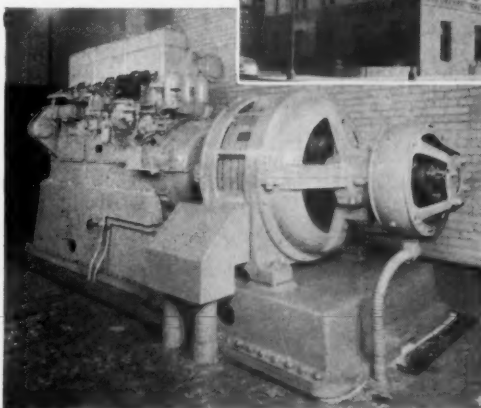
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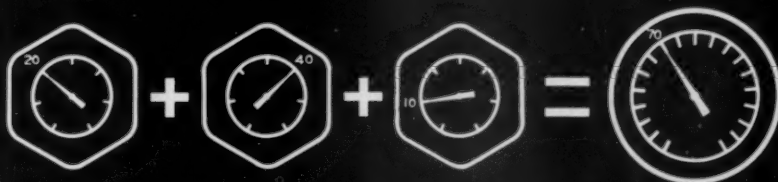
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(Continued from page 30)

*Resignations (Active)*

- BAKER, DONALD M. Cons. Engr., 1645 Vineyard Ave., Los Angeles, Calif.  
 BEASLEY, C. B. Sales Mgr., W. S. Dickey Clay Mfg. Co., Birmingham, Ala.  
 BECKER, ELMER W. Sr. Engr., Milwaukee Water Works, 2867 N. 72nd St., Milwaukee, Wis.  
 BERKEBILE, H. F. Supt., Rockwood Water Co., Rockwood, Pa.  
 CLASSEN, ASHLEY G. Supt., City Water Works, El Paso, Tex.  
 ELLIS, RANDALL N. Valuation Engr., City Attorney's Office, 206 City Hall, San Francisco, Calif.  
 FISCHER, FRED J. Chief Mechanical Engr., Dept. of Water & Power, 207 So. Broadway, Los Angeles, Calif.  
 GRANT, WALTER S. Jr., Alumni Hall, Virginia Military Institute, Lexington, Va.  
 GRIFFIN, H. K. Vice Pres., Peoples Water & Gas Co., 916 Weatherly Bldg., 516 S. E. Morrison St., Portland, Ore.  
 HALEY, F. W. Asst. Engr., with F. A. Barbour, 1119 Tremont Bldg., Boston, Mass.  
 HARRISON, J. M. Supt., Waterworks Dept., Wallaceburg, Ont., Canada.  
 HAYMAN, EDGAR M. Pres., Michael Hayman & Co., Inc., 856 E. Ferry St., Buffalo, N. Y.  
 JONES, W. R. Mgr., Power Product Dept., Johns Manville Sales Corp., 116 New Montgomery St., San Francisco, Calif.  
 MURPHY, FRANK M. Supt. of Distribution, City Water Works, El Paso, Tex.  
 NEVINS, E. Asst. Supt., City Water Works, El Paso, Tex.  
 PARKER, FRANCIS L. Ph.D., M.D., Parker Laboratory, 40 Broad St., Charleston, S. C.  
 PHILLIPS, EDWARD H. Asst. Secy. & Treas., Peoples Water & Gas Co., 916 Weatherly Bldg., 516 S. E. Morrison St., Portland, Ore.  
 POWELL, TREVOR J. Chief Installation Instructor, Johns Manville Sales Corp., 22 East 40th St., New York, N. Y.  
 PUTNAM, JAMES W. Iron Works Mgr., John Lysaght, Ltd., Casilla Correo 329, Buenos Aires, Argentina.  
 SHARP, A. S. Mgr. & Sect., Leadville Water Co., 719 Harrison Ave., Leadville, Colo.  
 SHERMAN, CHARLES W. Cons. Engr., Metcalf & Eddy, Cons. Engrs., 1300 Statler Bldg., Boston, Mass.  
 VERTEFEUILLE, JOSEPH A. Borough Engr., Dept. of Water Supply, Gas & Elec., City of New York, Municipal Bldg., Brooklyn, N. Y.  
 WHITTIER, W. E. 4218 Creed Ave., Los Angeles, Calif.  
 WING, FREDERICK K. Cons. Engr., 1314 Prudential Bldg., Buffalo, N. Y.  
 WITHERS, NEWTON. Dist. Mgr., Western Const. News, 206 S. Spring St., Los Angeles, Calif.

*Resignations (Corporate)*

- BATON ROUGE WATER WORKS CO. Mr. H. P. Connell, Sect.-Treas., P.O. Box 626, Baton Rouge, La.  
 FEDERAL LIGHT & TRACTION CO. Mr. H. A. Person, Acting Chief Engr., 70 Pine St., New York, N. Y.  
 KENTUCKY-TENNESSEE LIGHT & POWER CO. Bowling Green, Ky.  
 WAHIAWA WATER CO. Mr. A. A. Wilson, Wahiawa, Hawaii.

*Changes in Sections—January, 1939*

- DEMARTINI, FRANK EDWARD. From California to Ohio.  
 STONE, WYMAN R. From New York to South America.  
 KOPPERS COMPANY. From Indiana to Four States.  
 BACHMANN, FRANK. From Illinois to New York.  
 JONES, EARL F. From Indiana to Four States.  
 DIEHL, PAUL A. From Missouri Valley to Rocky Mountain.

## NEWS OF THE FIELD

This is a "Tale of Three Cities" and their water works superintendents. Ridgewood, Sheboygan, and Marion, middle sized cities in New Jersey, Wisconsin and Indiana, respectively, have had occasion to think quite a bit about their water departments within the past several weeks.

At Ridgewood, on March fifteenth, loyal fellow workers arranged a surprise birthday dinner for Arthur Carr. He has been superintendent of the city's water plant for twenty-five years. His friends take pride in that. The city is proud of his record—as well as its own record of political cleanliness. So the Mayor and the former Mayor and more than two hundred others sat down at dinner with Carr and told him and the rest of the country about this good record. The President of this Association was there and paid "tribute to a community so enlightened that it allows its water superintendent to operate without political interference and permits him to take advantage of all opportunities to produce results." The Ridgewood *News* editorially stated that "He [Carr] is the type of official who places duty above everything else and may well be continued in office." Members of this Association have recognized Carr's ability by making him chairman of the aggressive New Jersey Section. Certainly he is a deserving public servant, honored in his own time and among his own people.

In Sheboygan, there was sadness at the death of Arthur Miller. The board of water commissioners said, "We have lost a good man, a great leader and a true friend." This Association had recognized these qualities and had made him its Wisconsin Section Director.

But the finest thing about the Sheboygan attitude is the fact that the board of water commissioners did not fumble around in selecting Miller's successor. Promptly they elevated Jerome Zufelt to the position. A University of Wisconsin civil engineering graduate, since 1930 in charge of the filter plant and pumping station, Zufelt is recognized by water works men as being competent and just the type of man a city needs to put in charge of such an important public enterprise as the municipal water supply. This is another example of that fine state of municipal affairs in Wisconsin. Sheboygan, just as many other cities in that state, has for quite a few years placed the management of its water works in the hands of a board of commissioners. The standard of service in that state is high and beyond doubt reflects the wisdom of commission management of municipally owned public utilities. More than that, it evidences the fundamental good sense of the citizens who show that they want good

(Continued on page 2)

*(Continued from page 1)*

results from municipal technical services and recognize that petty partisan politics and good public service do not go together.

Marion, Indiana, is a sad and sorry story of the opposite type. There, since 1926, S. M. Van Cleave has been water works superintendent. Under his administration the profits of the department have increased from year to year. During his thirteen-year term of administration, a total of \$192,345 has been earned above the operating expenses of the water department. And Van Cleave, just as the rest of the progressive water works men of the country, was a member of this Association, took part in the affairs of the Indiana Section, and by attendance at section and district meetings in that area, increased his competency to serve the people of his city.

But—last November a new Mayor was elected. As time went on it became evident that a new superintendent (of the Mayor's political party) would be appointed. On March 2 the appointment was made and along with it came this revealing statement from the Mayor: "The change is being made primarily because of political reasons. I do not deny this but I insist that there can be efficiency in the department under a new superintendent as well as under the present superintendent." Of course every student of municipal administration knows that the Mayor is wrong. "Political" appointments do not promote "efficiency" and no amount of protestation can make it so. Training and experience and detachment from partisan politics are necessary elements of efficient management of municipal utilities and no amount of the politicians' wishful thinking can overturn these facts.

In his final report Van Cleave said:

"A municipal water works offers the same opportunity for profitable investment in service to the citizen-stockholder as a private utility of like nature offers in monetary gain for its owners.

"There are some 10,000 water works in the United States, more than 8,000 of which are municipally owned and operated. Many are highly successful as the result of good policies in management, while others are not so fortunate when they become victims of the strategy of politics which often contributes to failures.

"The success of any business institution does not 'just happen' even though it may have a monopoly in its product. In a public utility, the nature and amount of the service demanded must be studied and provisions made to render that service which meets the ideals of the consumer."

These things are true and now the city of Marion is going to learn how true they are while its new superintendent (the former office manager

*(Continued on page 4)*

## “NEW LIFE BEGINS AT 88”

**1830** In Richmond, Virginia, back in the days when Andrew Jackson was President, the city installed a 10-inch cast iron water main. This was a long time ago and the city fathers will be excused for not foreseeing that a larger size would ultimately be needed.

**1918** After 88 years of service in its original location, the growth of the city required replacement by a larger line of cast iron pipe. Inspection indicated the old main was in perfect condition. It was moved to a new location for further service.

**1939** Instead of buying new pipe for a needed water main, Richmond reclaimed the ancient 10-inch line and thereby saved a pretty penny for her taxpayers. The line was uncovered, inspected and approved for further service in 1931. It is still in use.

**LEST YOU FORGET** the high salvage value of cast iron pipe, we cite this example of reclamation after nearly a century of service. It is one of the three major economies of cast cast iron pipe, otherwise known as Public Tax Saver No. 1. More important, of course, are long life and lowest maintenance cost.



Look for the "Q-Check" registered trade mark.  
Cast iron pipe is made in diameters from 1¼ to 84 inches.

The Cast Iron Pipe Research Association, Thos. F. Wolfe Research Engineer, 1015 Peoples Gas Building, Chicago

# CAST IRON PIPE

## PUBLIC TAX SAVER NO. 1

(Continued from page 2)

of a plumbing concern) gets his education in water works management at the same time that he manages the department. For the sake of the people of the community, we think that he realizes his responsibility and will apply himself diligently in learning the skills of his new position.

There we have the brief "Tale of Three Cities." Two advanced far enough to understand that the management of city owned utilities, if successful, must not be politics ridden; the third, unhappy enough to be administered by a Mayor who says that politics and efficiency can exist together.

Fortunately, the number of intelligently governed cities is growing. Unfortunately, every election year has its Van Cleaves in some place or other. Whether a city is intelligently governed or whether it is politically administered is not a thing left to chance. Not at all. It is in the hands of the citizens when they vote and, more than that, in their control as expressed by their collective attitude.

If their attitude as co-owners of a municipal enterprise makes political

(Continued on page 6)

## For Underground Service Lines

### ANACONDA COPPER and RED-BRASS



Anaconda Copper Tubes in straight lengths and coils... Anaconda "85" Red-Brass in straight lengths only — both are products of dependable quality. Made by the world's largest and most experienced manufacturer of copper and brass, and stocked by leading supply houses.

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is clean and easy to handle and work. Those 10 lb. ingots don't mind rain or flood. No skilled labor needed. No delays when pot needs replenishing • Initial leakage heals almost at once, facilitating back-filling and tidying up of premises • And joints are permanently tight under any vibration conditions • Tegul-MINERALEAD has plenty of what you'll find in no other Bell and Spigot Jointing Compound.

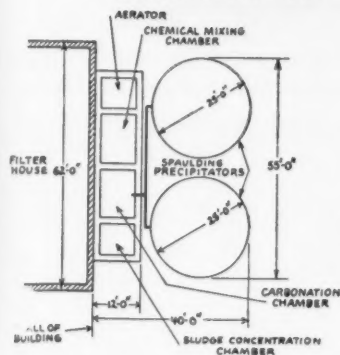
Write The ATLAS MINERAL Products Co. of Penna., Mertztown, Pa.

*Tegul*

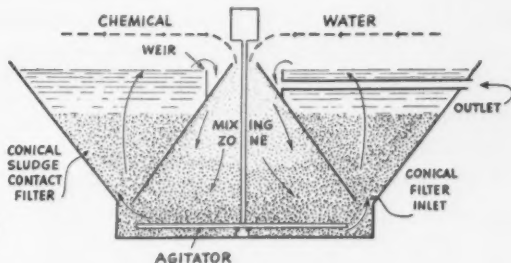


# A MORE STABLE WATER AT A LOWER COST

## Permutit's Spaulding Precipitator Revolutionizes Municipal Water Treatment!



**PLAN VIEW**—Note how compact this typical Spaulding Precipitator layout is! The Precipitator area is only 1540 sq. ft., less than half the 3399 sq. ft. of clarifier area needed for an equivalent cold lime plant of the conventional type.



**CROSS-SECTION VIEW**—The Spaulding Precipitator is completely new in principle. It consists of two compartments, (a) Mixing Zone (b) Conical Upflow Sludge Contact Filter. No settling of sludge takes place—an exclusive feature.

## Why you get clearer effluent with Spaulding Precipitator

In ordinary settling basins, sludge settles from water before full reaction takes place. In the Spaulding Precipitator, however, sludge is kept continuously suspended.

This feature speeds up precipitation, keeps sludge fresh. Softening is accomplished without putrefaction—water is so stable that recarbonation is often unnecessary.

In addition, the suspended sludge acts as a contact filter to make a clearer effluent than is possible with ordinary

cold lime treatment. The conical cross-section of the outer compartment keeps the sludge at uniform density. There is a sharp division between the sludge filter and the clear effluent.

These features not only give you a clearer effluent in a shorter time, but save real money on chemical costs, too. Write for illustrated booklet that describes the Spaulding Precipitator in detail. It's free. Address The Permutit Company, Dept. G2, 330 West 42nd Street, New York.

**PERMUTIT** THE WATER CONDITIONING HEADQUARTERS **OVER 25 YEARS**

(Continued from page 4)

appointments to the management of municipal utilities easy, political appointments will be made. If their collective attitude demands professional management for their utilities, they will get it.

The citizens create the problems by their need for and use of municipal services. They solve the problems of municipal management by their own collective action.

**C. M. Roos and W. C. Shoemaker** are leaving the Cairo Water Company, of Cairo, Illinois, to accept managerships elsewhere with the American Water Works and Electric Company. Mr. Roos will become Manager of the Peoria Water Company, of Peoria, Illinois, where Ray Crozier has resigned. Mr. Shoemaker has been appointed Manager of the Richmond, Indiana, water works, where he succeeds Howard A. Dill who is retiring from active duty.

Harry L. Hileman, who has been in charge of the office of the Cairo Water Company for the past seven years, first as accountant, then as cashier, is the new acting manager there.

(Continued on page 8)

### Chicago Installs 19,690 Feet of 36"-30" Mono-Cast Centrifugal Pipe



**R**APID delivery of approximately 20,000 feet of 36" and 30" Mono-Cast Centrifugal Pipe featured the installation of new water transmission mains in Lincoln Park, Chicago, Ill. Contract required speedy construction to help relieve unemployment in Chicago during winter months. Acipco's unexcelled production facilities for large-diameter pipe helped contractor keep ahead of schedule—another example of Acipco's dependable service. Write for literature.

**American Cast Iron Pipe Co.**  
BIRMINGHAM, ALA.

New York City Chicago Kansas City Minneapolis Dallas  
Los Angeles San Francisco Pittsburgh Cleveland

### Cathodic Protection for Steel Water Tanks

#### ELIMINATE

Rusting  
Corrosion  
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Painting  
below the water line.

*Guaranteed to save its cost  
at least once every four years.*

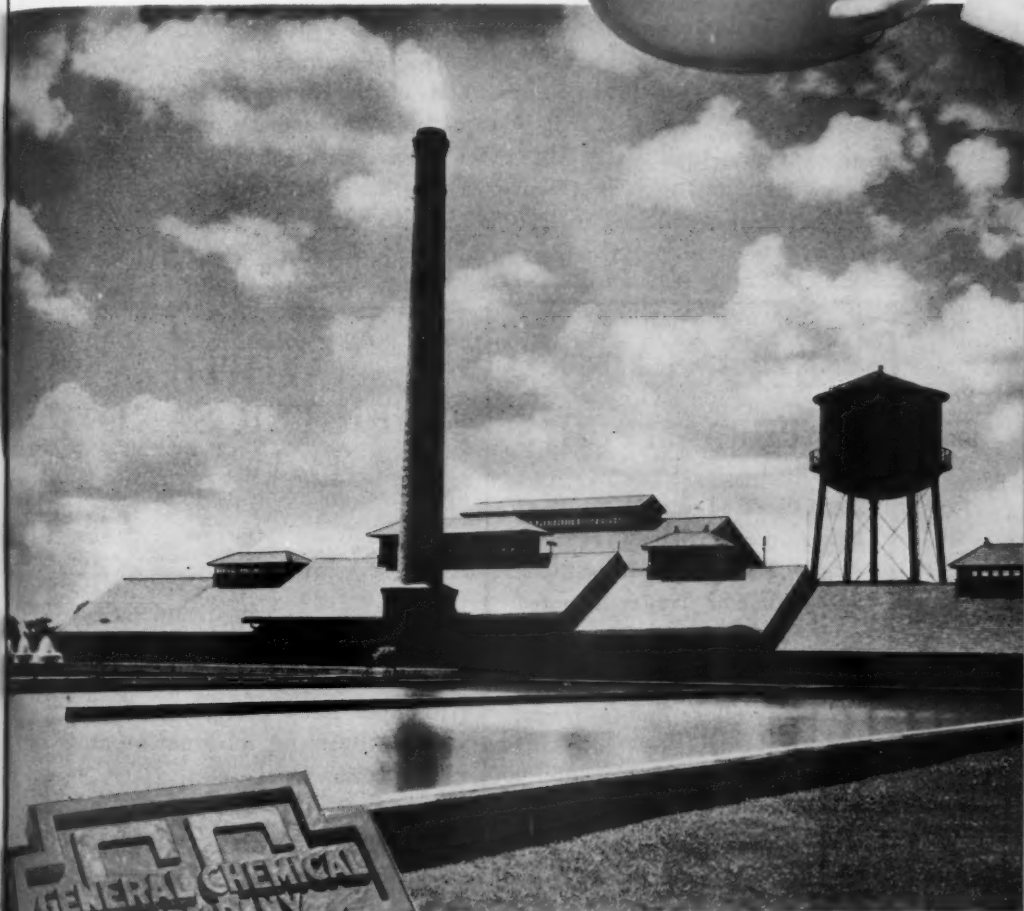


FREMONT, OHIO

# FOR AMERICANS EVERY DAY 5,800,000,000 GALLONS OF CHEMICALLY PURIFIED WATER

*General Chemical Company products for  
Water Purification and Sewage Disposal*

Aluminum Sulfate • Crystal Alum Ammonium  
Ferric Chloride • Copper Sulfate • Sodium Silicate  
Crystal Alum Potassium • Monosodium Phosphate  
Aqua Ammonia • Ferrous Sulfate • Sodium Sulfate  
Sodium Metasilicate • Sodium Hyposulfite  
Anhydrous Bisulfite of Soda • Phosphoric Acid  
Trisodium Phosphate • Disodium Phosphate



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*(Continued from page 6)*

**Michael F. Hoffman**, Assistant Superintendent of the Cincinnati Water Works, has been chosen secretary of a group that is seeking to devise a plan for a uniform basis for the formulation of public utilities rates and standardized reports of public utilities to public utilities commissions. Mr. Hoffman attended a meeting of the group in Chicago in early March as a representative of the American Water Works Association in which he is Chairman of the Finance and Accounting Division.

Other groups represented at the Chicago meeting were: The American Gas Association, The Edison Electric Institute, The Electrical Advisors' Association, The Columbia Gas & Electric Corp., The Standard Gas & Electric Corp. of New York, public utility commissions, and the national associations of railroads. Mr. Hoffman expects that a preliminary report will be ready for submission at the Atlantic City Convention.

**Clarence E. Ploch**, Superintendent of the municipally-owned Mt. Vernon Water Works Co., Mt. Vernon, Indiana, has been granted a leave of absence due to illness. Mr. Ploch's leave of absence is of indefinite length depending upon his recovery. He has been an employee of the Mt. Vernon Water Works Co. for 37 years.

*(Continued on page 14)*

## EDSON DIAPHRAGM PUMPS

Hand Operated—size 2", 2½", 3", 4"

Power Operated—size 3" and 4"

Open Discharge or Force Pump  
Skid, Truck or Trailer Mounted

Complete Pump Outfits, Genuine  
Edson Pumps, Suction Hose,  
Brass Couplings, Bronze Clamps,  
Red Seal Diaphragms,  
Brass Strainer or Foot Valve,  
Hose Spanners, Adapters, Etc.  
Standard Hydrant Protector,  
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## WHITE FILTER SAND 98% Pure Silica



Washed, Screened and Dried.  
No Freight on Moisture—  
Prompt shipment in Bags or  
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# ***Salt announces a team..***

## **THAT OFFER YOU GREATER SAFETY !**

Here are two products which both individually and jointly bring increased dependability to the purification of water supplies. The first is an exceptionally pure liquid chlorine that minimizes chlorinator irregularities arising from the quality of the chlorine itself.

Knowing that liquid chlorine of high purity will materially reduce operating difficulties, this Company developed a new purifying

process which removes virtually all organic impurities from the liquid chlorine we supply to you. Hexachloroethane—the chief constituent in “taffy”—is out!

As a means of manufacturing control, we have developed an improved analytical method of evaluating chlorine as to such impurities. You can be sure that this pure product will go far to maintain smooth operation of your equipment.

In case of storm, flood, blizzard, or other catastrophe, your normal supply of liquid chlorine may be temporarily shut off by a tie-up of transportation. In such emergencies, a supply of Perchloron means safety.

Perchloron, with an available chlorine content of over 70%, is concentrated, stable, and uni-

### **AND FOR EMERGENCIES**

**... a second  
line of defense**

form. Dissolves readily in water. Packed 12 handy cans to the case, each can with punch-and-pry-up top. Comes

also in 75 lb. drums. You will find it of value, not only for emergency chlorination, but for sterilizing new mains, for clear wells and filters, and for swimming pool sanitation. Why not write for free booklet?

PENNSYLVANIA SALT MANUFACTURING COMPANY • Est. 1850  
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NEW YORK • CHICAGO • ST. LOUIS • PITTSBURGH • TACOMA • WYANDOTTE



**PENNSYLVANIA SALT  
MANUFACTURING COMPANY**

*Chemicals*

## New Materials and Gadgets

1. **An Acid-Proof Flow-Control Valve** has been developed to handle any acid except hydrofluoric, fuming sulfuric, or highly oxidizing reagents or strong alkalis. The valve is completely lined with rubber except for the tantalum seat and plug.
2. **A Portable Recording Thermometer** is now on the market. It weighs less than 2 lb. and its dimensions are 5 x 6 x 2½ inches.
3. **An Eye Shield** is now made that does not rest on the nose or interfere with the use of eye glasses. The visor is made of material that will not ignite spontaneously like celluloid.
4. **A pH Meter**, designed to operate from a 110-volt a.c. supply, employs shielded glass electrodes and may be installed in flow lines without stray currents. To maintain a desired acidity, it is coupled to a recorder and to an automatic controller mechanism.
5. **A New Substance** to treat galvanizing for paint is designed to remove dirt and grease and build up a surface to which paint will adhere.
6. **Carbon and Master Copy Sheet** for either spirit or gelatine process of hectograph reproduction have been combined in one unit for easy preparation. The carbon is easily attached for reproduction of the master.
7. **A Flexible All-Steel Hose** has been designed to resist vibration and, being made in one piece and gas-tight, it is marketed for service in the most exacting circumstances.
8. **Continuous Inkless Recording Instruments** for ammeters and voltmeters have been put on the market. They are portable, but may be wall- or pole-mounted. The record is a series of dots made through a typewriter ribbon.
9. **Labels** that will adhere well without moistening to smooth, non-porous surfaces such as glass metals, plastics, etc. are now available. It is claimed that in spite of the strong adhesive quality the labels can be removed without leaving a trace of their presence.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items and citing the April issue as the source.

# You're the doctor

## WHO CAN CURE SUCH COSTLY PIPE DISEASES AS TUBERCULATION



Tuberculation costs many a water works thousands of dollars a year. So do pipe corrosion and electrolysis . . . all the familiar troubles that keep maintenance crews busy. Most of them are unnecessary! Asbestos-Cement pressure pipe puts an end to them, saving not only on maintenance, but on pipe replacements and pumping costs as well.

Now, The Keasbey & Mattison Company, the pioneers in asbestos development, bring you "Century" Asbestos-Cement Pressure Pipe . . . a superior product of high, uniform strength, made by a new and improved process. A pipe that provides exceptionally long service life. A pipe

easily handled and laid because of its light weight. Non-tuberculating, non-corrosive, never attacked by electrolysis. Each length is subjected to a hydrostatic test of twice its normal working pressure.

**FREE** — Complete, illustrated catalogue on "Century" Asbestos-Cement Pressure Pipe. Covers every phase of the subject, answering all your questions in detail. This book may help to save you thousands of dollars in pipe maintenance, in replacements, and in pumping cost. Mail the coupon today for new catalogue, "Mains without Maintenance."

Be sure to visit the K & M exhibit in the Home Building Center at the New York World's Fair.

**KEASBEY & MATTISON COMPANY**  
AMBLER, PENNA.

District Sales Offices in Principal Cities

### MAIL THIS COUPON

KEASBEY & MATTISON COMPANY, AMBLER, PENNA.

Send me, without obligation, free catalogue on "Century" Asbestos-Cement Pressure Pipe — "Mains without Maintenance."

NAME \_\_\_\_\_

NAME OF PLANT \_\_\_\_\_

ADDRESS \_\_\_\_\_



(Continued from page 8)

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**Arthur Bielot**, one of the Association's new and younger members, died of pneumonia in Detroit on March 8. Mr. Bielot had served 15 years in the Department of Water Supply in Detroit, first as Laboratory Aid then as Junior Chemist. Those who knew him and worked with him had great respect for his unassuming, conscientious, trustworthy, and unselfish ways in work and private life.

**John A. Hanley**, Keeper of the Kilbourn Park Reservoir at Milwaukee, died on March 11. Mr. Hanley was 83, had served in the city water department for 55 years, and had held his position at the Kilbourn Park Reservoir since 1892. His father had been keeper of the same reservoir for 30 years before him.

---

**Lock Joint Pipe Company**, Ampere, New Jersey, has issued a 16-page description of the development of a new soft water supply for Little Rock, Arkansas. Aside from its merit as a description of the Little Rock development, the publication is an excellent example of the modern trend to the use of illustrations to tell a story.

**Payment of water bills by a lien** on the property served is the purpose of a bill developed and sponsored by the Michigan Section. Water liens have been ruled invalid in the courts of Michigan and injunctions have been issued restraining water departments from shutting off service for non-payment of bills. The Michigan Section has held several meetings and has evolved a bill for introduction to the State Legislature. The bill provides that any municipality operating a water distributing system shall have as security for the collection of water bills a lien upon the house or other building or premises served. This bill would not supersede existing legal means employed by municipalities in Michigan but would add the security of a lien.

(Continued on page 16)

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## OUR ZEOLITES—BASEX AND HI-BASEX

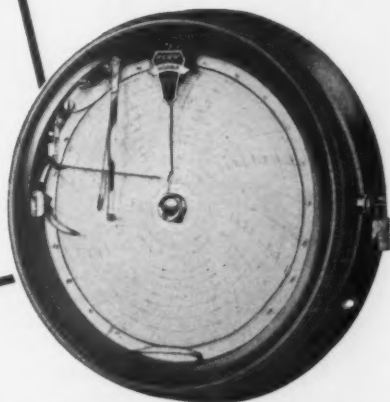
**Perfection in highly refined, durable, efficient greensand zeolites for open gravity or closed pressure water softeners.**

*Extensively used with entire satisfaction for over 15 years*

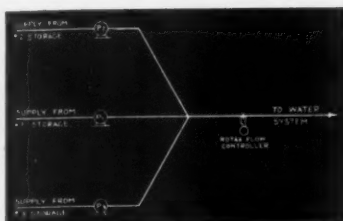
*Send for Details*

**HUNGERFORD & TERRY, Inc.**, Clayton, New Jersey  
also manufacturers of the well known **INVERSAND** water softener

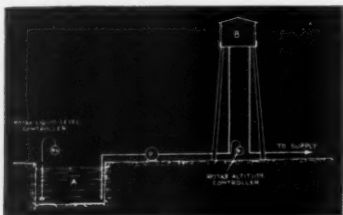
# Automatic Pump Control



... plus SIGNALS for better operation



Rotax Control of three pumps may be handled as illustrated. With pump No. 1 working under normal conditions, the Rotax Controller will start pumps No. 2 and 3, respectively, when needed.



Rotax Control as applied above maintains the proper level in tank "B", and prevents the pump from operating when the water level "A" falls below a minimum level and until it again attains a working level.

Your pumps will do a better, more efficient job with Foxboro Rotax Control. This perfected electric contact Controller combines reliability . . . flexibility . . . accuracy . . . and long life. It is the proved, modern way to use electricity as the operating medium for control and signals.

Because commutator-type contacts are used there is absolutely no interference between the measurement and control devices. A single Rotax Controller may be made with as many as four separate contacts. The contact combinations make it easy to satisfy practically every control requirement. Outside setting makes adjustment for any control point easy. Insist upon *control plus signals* so that you have immediate notice should abnormal conditions occur. > > > Bear in mind, Rotax Control is also available for temperature and humidity. Whatever your need . . . if you want accurate control by means of an electrically operated controller investigate the possibilities of Foxboro Rotax Control. Bulletin 184-2 describes many applications of this modern Controller. Write for a copy.

## THE FOXBORO COMPANY

150 Neponset Ave., Foxboro, Massachusetts, U. S. A.

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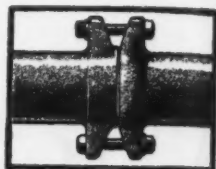
## AUTOMATIC PUMP CONTROLS

# UNIVERSAL <sup>CAST IRON</sup> PIPE

## LAID WITH JUST WRENCHES



No other tools are needed. No lead, no pouring, no bell holes to dig. Machined iron-to-iron flexible joints. **SPEEDIEST...EASIEST...SAFEST.** Highest quality Cast Iron.



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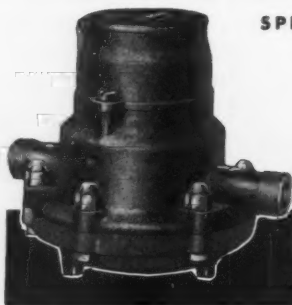
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A public works program for Canada has been announced as the plan of the Dominion Government to come before the legislature at Ottawa, Ontario. Last year legislation was passed authorizing the loan of money at 2 per cent interest for self liquidating projects such as water works. While the details of the new proposal have not yet been divulged, it is expected that grants will be made for certain specified public works projects. The plan is likely to be that 40 per cent of the labor costs be paid by the Dominion, 40 per cent by the province, and the balance of labor costs and the entire equipment cost to be met by the municipality.

The Grand River Conservation Scheme in the province of Ontario is approaching the construction stage. H. G. Acres and Co. of Niagara Falls, the Consulting Engineers, have submitted a report to the commission outlining the work to be done, and it is anticipated that construction will be started this year. The project is a major drainage undertaking designed to control floods and to maintain an increased flow in the summer months. The normal variation in this stream is large, but by the installation of

(Continued on page 18)

## FIRST QUALITY METERS EXCLUSIVELY



SPECIFY

*American or Niagara*  
(BRONZE CASE) (IRON CASE)

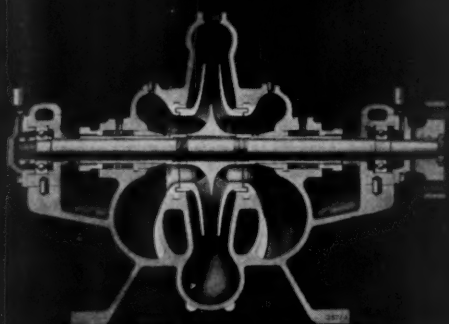
*Water Meters*

WRITE FOR CATALOG

**BUFFALO METER COMPANY**

Established 1892

2914 Main St., Buffalo, N. Y.



Single stage, double suction pump  
with ball bearings.



Sleeve bearing pump, with  
casing cover and bearing caps lifted.

# PUMPS

## FOR ALL PURPOSES

De Laval Centrifugal Pumps are characterized by high efficiency and exceptional reliability, obtained by scientific design based on exhaustive development and tests, by the use of the most suitable materials, and by precision manufacture on a limit gage, interchangeable basis.

The casing is split in the horizontal plane of the shaft and internal parts are accessible and removable upon lifting casing cover and bearing caps. At all points subject to wear the main pump parts are protected by renewable wearing parts, the most important of which are the labyrinth rings which reduce leakage from discharge to suction, while permitting ample mechanical clearances.

Each pump is guaranteed as to mechanical perfection and operating characteristics and is tested before shipment from the De Laval Works.

State your pumping requirements fully and appropriate literature, with suggestions concerning the most suitable type and arrangement of pumping equipment, will be sent.



# DE LAVAL

*Steam Turbine Co.*  
TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES, PUMPS - CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT  
CENTRIFUGAL BLOWERS AND COMPRESSORS, WORM GEARS, HELICAL GEARS, HYDRAULIC TURBINES  
AND FLEXIBLE COUPLINGS. SOLE LICENSEES OF THE RAUER-WACH EXHAUST TURBINE SYSTEM

*(Continued from page 16)*

dams this can be equalized, and a reasonable dilution secured for the sewage effluents reaching the stream.

The city of Kingston, Ontario, has initiated proceedings for the construction of a modern water filtration plant. Kingston is the last of the large centers, taking water from the Great Lakes, to install filtration. C. C. Folger, as manager of the Public Utilities Commission, has taken an active interest in safeguarding and improving the city's water supply. Gore and Storrie, Consulting Engineers of Toronto, have been asked to report on the filtration project which is closely linked with Kingston's plans for sewage disposal.

Approximately \$2,000,000 is being expended on 20 water works projects in upstate New York under the initiative of the 1938 PWA program. Work involved includes the installation of new water supply systems, new filtration plants, and improvements to existing plants, the development of additional sources of supply, and provision of more adequate storage facilities. Municipalities in which work is being done are: Alfred, Ba-

*(Continued on page 20)*

## The fire hydrant for present-day service and traffic conditions



**T**HE Kennedy SAFETOP meets every requirement of strength, safety and economy as well as instant readiness and reliability in service.

It is strong enough to resist any ordinary impact; but if broken by a collision which no hydrant could resist, it is speedily and economically returned to service, without excavation or shutting off the water supply.

Its easy elbow and nozzle curves and its extra-large standpipe assure minimum pressure loss; and its simple, straight-line operating mechanism assures positive operation without danger of sticking.

The Kennedy Valve Mfg. Co., Elmira, N. Y.

**KENNEDY  
SAFETOP  
U.S. PAT. 2,148,841  
FIRE HYDRANT**

**CITY COMPLETES  
WATER MAIN  
CLEANING PROGRAM**

**COST IS \$99,241.45**

For years water pumping costs have been excessive and in many parts of the city pressures adequate for proper fire protection could not be maintained. Consequently the City Water Department decided to clean more than 500,000 feet of main.

You'll save expense items like this by using enamel lined Armco Spiral Welded Pipe for all water supply lines. You'll also assure higher flow capacity and lower pumping costs for your city.

*Eliminate pipe cleaning bills  
— before they start*

Many cities are forced to clean their water mains at regular intervals. While this work is justified on existing mains, it nevertheless represents an expense that can and should be avoided in the design of new supply lines.

Armco Spiral Welded Pipe with a spun enamel lining assures the highest possible flow per inch of pipe diameter. This high flow capacity will remain constant through

the years because the smooth spun-lining definitely prevents tuberculation.

Added to these advantages, Armco Pipe costs less to handle and install than heavy, rigid types. Used with Dresser Couplings it assures sturdy water-tight line that will serve as long as you need it, without costly breaks.

Write for complete story. The American Rolling Mill Company, Pipe Sales Division, 771 Curtis Street, Middletown, Ohio.



**ARMCO**



**SPIRAL WELDED STEEL PIPE**

APPROVED BY UNDERWRITERS LABORATORIES, INC.

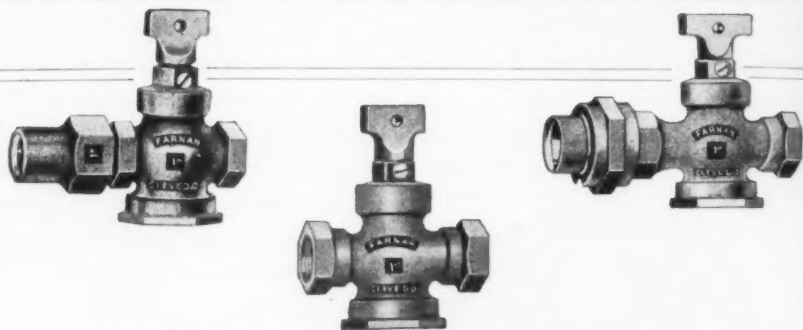
*(Continued from page 18)*

tavia, Binghamton, Cobleskill, Cornwall, Cortland, Croton-on-Hudson, Cruger's-Oscawana District, Gloversville, Goshen, Hanover District, Leicester, Lewiston, Livonia, Ovid, Peekskill, Warsaw, Watervliet, West Hempstead and Yonkers.

Sewerage projects constitute the bulk of the construction in the PWA program with 51 works of this type entailing an expenditure of more than \$12,500,000. Included are 18 new sewer systems and sewage treatment plants, 15 intercepting sewers and sewage treatment plants, 3 treatment plants with incinerators, 7 additions and alterations to treatment plants and 8 miscellaneous projects.

Contracts have been awarded the Chicago Bridge & Iron Company for the construction and erection of a 1½-million-gallon tank to serve the Blue Ridge Section of Indianapolis, Indiana. Plans are being prepared for a 16 m.g.d. water treatment plant which will develop an additional primary water supply from Fall Creek for Indianapolis.

A gift of a birthday was made by the Board of Water and Power Commissioners of Los Angeles to Van Jerome Miles, an American Indian and

*(Continued on page 22)*

## FARNAN CLEVELAND

TWO WORDS—FARNAN CLEVELAND—these are all you need to remember to insure your obtaining the highest grade brass stops, couplings and fittings that can be purchased at any price anywhere. **Quality Plus,** and **Durability Plus,** mean **Economy Plus.**

**THE FARNAN BRASS WORKS CO.**  
**CLEVELAND** ESTABLISHED 1852 **OHIO**

# MATHIESON *HTH* FOR SAFE BEACHES



**MATHIESON CHLORINE  
FOR SAFE DRINKING WATER**



Says George R. Young, Village Manager,  
Village of Glencoe, Illinois:

March 7, 1938

"You will be interested in our successful use of HTH on our Lake Michigan Beach. . . Two problems were involved: foot infections from the bacteria in the sand, and insects. . . HTH was tried, using a 2% solution. We were able with this solution sprayed on the sand to reduce the fly egg count from 800 per square inch to almost none. We eliminated bacteria and foot infection completely, so far as we were able to determine. We feel that the added satisfaction and confidence inspired in our Glencoe residents who use the beach was well worth while. . . In the past ten years we have enjoyed excellent service from your company."

• *Municipal Bathing  
Beach, Glencoe, Illinois.*

• *Filtration Plant  
Glencoe, Illinois Water-  
works.*

HTH is a dry, free-flowing chlorine carrier. 70% of its weight is chlorine available for killing bacteria and destroying odors and other objectionable contamination. Its germ-killing power is released rapidly, uniformly — requires no bulky equipment, no specially expert or experienced operator. Best of all HTH really does the job.

Glencoe is only one of the many villages, towns and great cities throughout the country that have found in HTH and Mathieson Chlorine the ideal solution of the problem of water purification, sewage treatment, beach and pool sanitation.

Mathieson Chlorine means a pure, dependable product — safe, trouble-free containers and valves — prompt delivery service. In addition you have available the full cooperation of Mathieson's expert technical staff.

**THE Mathieson Alkali Works (INC)**  
60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE... HTH... SODA ASH... CAUSTIC SODA... BLEACHING POWDER... BICARBONATE OF SODA... AMMONIA, ANHYDROUS and AQUA... PH-PHUS (FUSED ALKALI)... DRY ICE... LIQUID CARBON DIOXIDE... GYPSUM PRODUCTS

(Continued from page 20)

an employee in the Water Bureau Meters and Service Division. Mr. Miles had no birthday so the Commissioners decreed that he was 43 years old and should hold his first birthday celebration on April 1. The action was necessary in connection with the Los Angeles Retirement Plan.

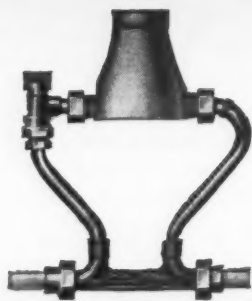
The people last November in Massillon, Ohio, refused to approve of an extra tax assessment to provide funds both for fire hydrants and street lights. As of December 31, the city owed the Ohio Water Service Company \$128,688, a debt which was increasing at the rate of over \$2,000 a month. During negotiations for payment of the debt, the water company has offered concessions to a total of \$91,000. The city council has now passed an ordinance granting the water company the right to increase the rates to consumers. The added revenue will bridge some, but not all, of the gap between the accumulating debt and the concession offered by the water company.

Water softening plans for water from the Colorado River aqueduct have been approved by the directors of the Metropolitan Water District of Southern California. Contracts for sludge removal equipment and

(Continued on page 26)

## The Coppersetter

A COMPLETE METER MOUNTING



The COPPERSETTER is a simple, convenient and durable fitting for installing water meters in horizontal service lines. It is all brass and copper, made in several heights and can be provided with an inverted ground-key angle valve at the meter inlet. Write for more information about the COPPERSETTER.

**The Ford Meter Box Co.**  
WABASH, INDIANA

**KUPFERLE  
FIRE HYDRANTS**  
COMPLY WITH the specifications  
of the Am. W. W. ASS'N.

and are backed by an enviable  
reputation of complete depend-  
ability in service.

Specification sheets  
sent on request

**John C. Kupferle**  
FOUNDRY CO.  
ST. LOUIS



**MORRIS KNOWLES, INC.****Engineers**

Water Supply and Purification, Sewerage  
and Sewage Disposal, Valuations,  
Laboratory, City Planning.

Pittsburgh, Pa.

**METCALF & EDDY****Engineers**

Water, Sewage, Drainage, Garbage  
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Laboratories	Valuations
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**REEVES NEWSOM****Engineer - Consultant**

Supply, Purification and  
Distribution of Water

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Analysis of the water supplies  
for municipalities, industrial  
plants, private estates and  
camps. Swimming pool control.

Chemists Field Sanitary Surveys  
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Consulting Engineers for Water Supply, Water  
Purification, Sewerage, Disposal of Sewage, and  
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WATER WORKS - SEWERAGE - UTILITIES

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Albany, N. Y.

**THE PITOMETER COMPANY****Engineers**

Water Waste Surveys  
Trunk Main Surveys  
Water Distribution Studies  
Penstock Gaugings

50 Church St. New York City

*Help Build up Your Association  
by Bringing in a New Member*

SEND FOR  
APPLICATION BLANK

AMERICAN WATER WORKS  
ASSOCIATION

22 East 40th St.

NEW YORK CITY

(Continued from page 22)

floculators have been let to the Dorr Co., Inc., of New York City. The plant with a 100 m.g.d. capacity will be built at Sandimas, with provision for future expansion to a capacity of 400 m.g.d. The plant will have a lime removal system with part of the flow treated by lime zeolite process to yield a hardness of 125 p.p.m. Sludge will be regenerated by burning. Hoover and Montgomery are consultants for the project.

"Doctor Jones" who writes informally in *Health News*, the publication of the New York State Department of Health, says he was reading a book awhile ago with the plot laid in London about 1644, at the time of the big bubonic plague. He goes on to say:

"But what I was thinking about, particularly: I can't remember that, in that whole story, there was any mention of rats, not in connection with the plague, anyway—and yet we know now that they were at the bottom of the whole thing—and, of course, the fleas that carried the infection from the rats to the humans. Not only that but it's rats that are keeping bubonic plague going today."

(Continued on page 28)



## STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains—under paved streets, railroads or over bridges—you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

### HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church Street, New York, N. Y.  
General Offices and Works: West Medford Station, Boston, Mass.

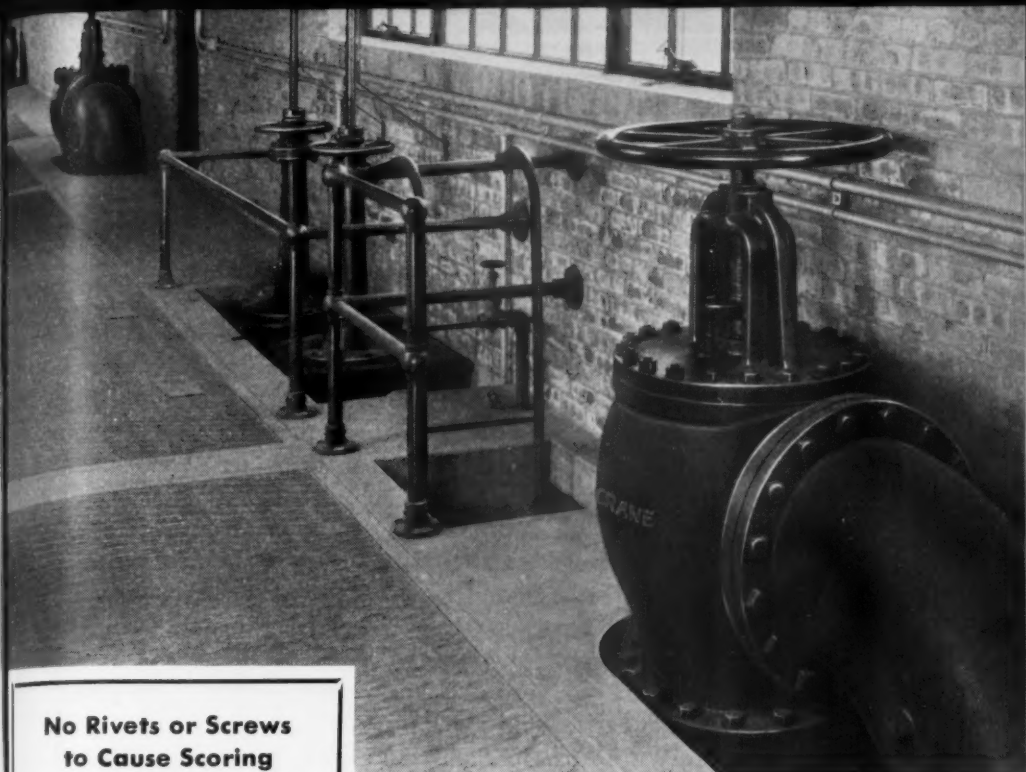


A Symbol  
of  
Quality

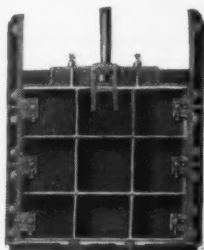
# HYDRO-TITE

Reg. U.S. Pat. Off.

A DEPENDABLE SELF - CAULKING JOINT COMPOUND



**No Rivets or Screws  
to Cause Scoring  
in Crane Sluice Gates**



There are no rivets or screws in Crane Sluice Gate seats to work loose and interfere with smooth operation—to cause burrs that cut deeply into seating surfaces. The Crane method of seat mounting avoids this danger. Crane bronze seats are rolled into dovetail grooves of ample section machined in the face of the disc. After rolling seat facing into the grooves, seating surfaces are machined to a smooth tool finish.

That's just one of the many reasons why Crane Sluice Gates give superior service—smooth and positive through long years. Crane's vast experience and facilities in engineering water control equipment back up the dependability of every part—frame, disc, guide rails, operating mechanism—assure faithful performance. Consult your Crane Representative.

## BECAUSE OF VALVES A CITY WILL BE SAFE

IT takes valves—lots of them—to furnish pure water to cities—to dispose of disease breeding wastes. Here on an air line leading to the aerating tanks in a large sewage treatment plant are Crane No. 353 Angle Valves—a whole line of them—selected for this duty because of the constant, reliable, trustworthy service Crane Valves may be expected to perform.

But whether it's a sewage treatment plant or a filtration plant—whether the service is shutting off a main—or handling chlorine gas for water sterilization—whether the valve is intended to control the flow of air or water, steam or gas—there is a Crane valve just built for that job.

The Crane No. 52 Catalog is designed to help you solve your problems in flow control. It gives complete information on valves built to A. W. W. A. specifications for waterworks service—and in addition it contains a gold mine of information on waterworks problems for the engineer or superintendent. Make it a habit to check with your Crane Catalog on any valve or piping item you may need—you will find it listed and described in the 38,000 items contained in this book. You will find, too, that Crane nation-wide service means stocks quickly available to meet your demands.

# CRANE

CRANE CO., GENERAL OFFICES  
836 S. MICHIGAN AVE., CHICAGO  
VALVES • FITTINGS • PIPE  
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

(Continued from page 26)

**George C. Sopp**, Meter and Service Inspector, Bureau of Water Works and Supply, Los Angeles, California, reports further details of the jet meter for automatic sewer flushing which was described in his paper "Gadgets Become Standard Equipment" (Jour. A. W. W. A., 31: 114 (1939). The bodies of the meters are manufactured by the James Jones Company, 201 Le Roy Street, Los Angeles, and the hard rubber disks are made by Neptune Meter Company, 50 East 42nd Street, New York City. The various sizes of wire and the stainless steel bridge to hang the wire on are shaped and stamped out in the Bureau of Water Works meter shop. Specifications and blue prints can be obtained from Mr. Sopp.

"Rural Ohio in this year of grace 1939 has every modern convenience except one—that one is so basic and indispensable that without it communities cannot grow." This and the following are quoted from the Lancaster, Ohio, *Eagle-Gazette*.

"The farmer has the radio to bring him world news and stock quotations. An automobile carries him about his duties, and a tractor pulls his plow. He turns a switch for light, and cooks with gas. Electric

(Continued on page 30)

## CLEAN YOUR WATER MAINS

One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

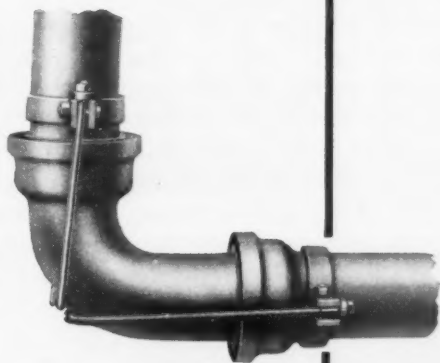
### National Water Main Cleaning Co.

50 Church St., New York, N. Y.

#### BRANCHES

115 Peterboro St., Boston, Mass.  
910 William-Oliver Bldg., Atlanta, Ga.  
7103 Dale Ave., St. Louis, Mo.  
208 E. Forsyth St., Jacksonville, Fla.

3812 Castellar St., Omaha, Neb.  
2587 Glen Echo Drive, Columbus, Ohio  
501 Howard St., San Francisco, Calif.  
58 Pelham Ave., Toronto, Canada.



## Don't Take Chances

Everywhere that water stops or changes its course, Grinnell's wide line of Socket Fittings offers a full measure of service and quality.

Grinnell elbows — tees — crosses — clamps—valves of all types, assure you easy, compact installations . . . trouble-free operation.

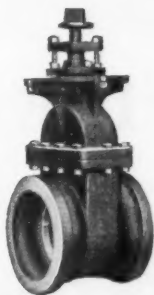
Conveniently located warehouses make for prompt delivery. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

**SOCKET FITTINGS**

**BY**

# GRINNELL

... WHENEVER PIPING IS INVOLVED ...



(Continued from page 28)

machines milk his cows and help his wife with her house-keeping. In most respects the ruralite is as well-equipped as his city brother who lives amid the marvels of a mechanical world.

"But the farmer has no bathroom, and in that respect he is little worse off than thousands of people living in small villages. Southward through central Ohio flow three rivers toward the Ohio, the Mad, the Scioto and the Muskingum. These three rivers furnish water to the nearly a million people living in 20 counties of their basins. They furnish water and an outlet for sewage. To a large extent, the people living in these counties outside the cities are chained to the conditions about which James Whitcomb Riley wrote with humor and delicacy.

"Even in the city of Delaware, within the last two years an aged couple knew the decent luxury of a hot bath in a tub in a gas-heated bathroom for the first time, in their own home, in the fifty years they had lived in the same house. An extension had been added to Delaware's sanitary sewer system, and the aged couple built a bathroom addition to their home.

(Continued on page 32)

## Warren Foundry & Pipe Corp.

ALSO

Warren Pipe Co. of Mass., Inc.

SALES OFFICES

11 BROADWAY, NEW YORK  
75 FEDERAL ST., BOSTON, MASS.

Manufacturers of

## CAST IRON PIPE

Sizes 2" to 84"

*Flanged Pipe*

*Flexible Joint Pipe*

*Bell and Spigot Pipe*

*Special Castings*

*Short Body B. & S. Specials*

Warren  *Spun Centrifugally Cast Iron Pipe*

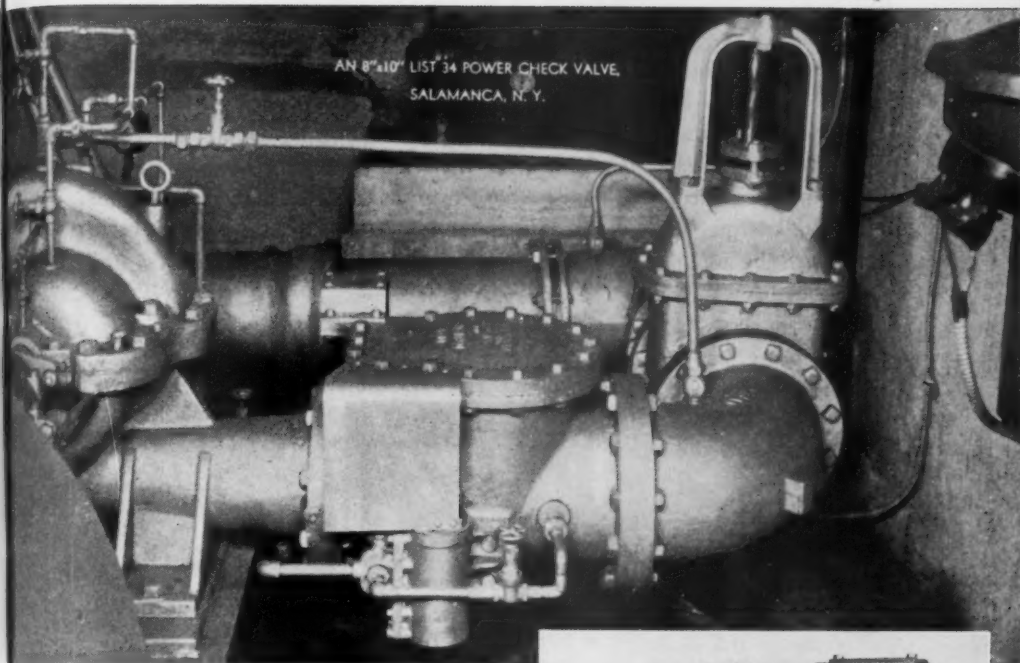
WORKS: PHILLIPSBURG, N. J. and EVERETT, MASS.

Large Stock Enables Us to Make Prompt Shipments

FOR QUIET CLOSURE & MAXIMUM EFFICIENCY-INSTALL

# RENSSELAER

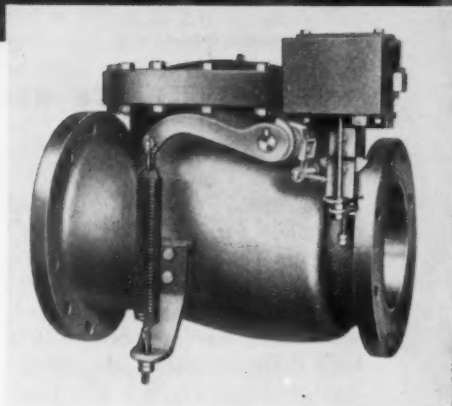
## LIST 34 POWER CHECK VALVES



AN 8"x10" LIST 34 POWER CHECK VALVE  
SALAMANCA, N. Y.

- Positively eliminates slam on pump shut-down.
- Full clearway opening reduces head loss and cuts power costs.
- Simplicity of design and rugged construction results in trouble-free operation over a period of years.

Bulletin "V" mailed on request



**RENSSELAER VALVE COMPANY, TROY, N. Y.**

*(Continued from page 30)*

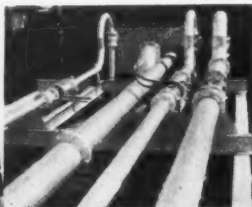
"A WPA project made possible the extension. WPA's District Six includes the 20 counties lying in the drainage basins of the three rivers which give water to a million people. In the same area are a limited number of cities, and 160 villages. The cities have sanitary sewage systems and water pressure systems. The villages, by and large, do not.

"There are 160 villages in the 20-county basins, and until the last few years 136 of those same villages had nothing in the way of modern sewage disposal facilities. The septic tank and the outhouse were common. In the same area, 30 villages had grown through the course of years to a population of 1,000 persons or more. In that range, WPA projects in the last four years have cut the lack of modern disposal systems exactly in half.

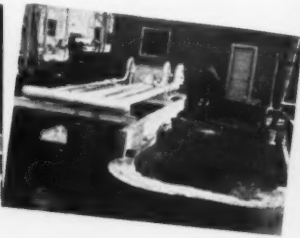
"Fifteen complete sewer and disposal systems have been built by WPA projects in the last four years in Central Ohio. Three villages now are using pressure water systems through the same source. Thus, in more than 50 per cent of the upper class villages, the outhouse, the septic tank and the old oaken bucket are on their way toward the fate of the horse-and-buggy."

*(Continued on page 35)*

*Venturi Manometer  
accurately indicates flow*



*3", 5", and 8"  
Venturi Tubes in test lines*



*Flow discharges into weir channel*

## Venturi Meters used in rating Layne Pumps

Today many leading pump manufacturers use Venturi Meters for pump rating tests. (Photos show test layout made for Layne & Bowler, Inc., by their Chief Engineer, A. B. Fabrin.) For a modest investment the pump manufacturer gains in two ways: (1) he saves time as compared with use of weir measurements; and (2) in using Venturi Meters he is rating his pumps against the same standard of flow

accuracy which will be used in the field "acceptance tests".

Whether you want to meter flow, with Register located adjacent to the Tube; or whether the reading must be transmitted miles away to show flow rates to distant supervisors, or to automatically control operation of pumps, Venturi accuracy is important.

*Write for bulletins*

**BUILDERS IRON FOUNDRY, 9 Coddling Street, PROVIDENCE, R. I.**

Copies of  
**Graph & Nomogram**  
from

**Charles P. Hoover's**

**Practical Application of  
the Langelier Method**

Jour. A. W. W. A., 30: 1802 (1938)

are now available at  
the A. W. W. A. office.

Send 10 cents in stamps  
or coins for single copies,  
to cover cost of printing  
and mailing, to:

**American Water Works  
Association**  
22 East 40th Street  
New York City

These copies are flat, un-  
bound, unaccompanied  
by text matter.



## *When father was a boy*

Even so short a time ago as our father's generation, there was still much localized resentment against installing "these damn-fangled costly water systems". "If our water was good enough for my father to drink..." was heard in many a town meeting of that time.

Today, the typhoid rate of North America is the lowest in history... adequate confirmation that liquid chlorine is doing its job well.

Solvay's new "Big 3" Liquid Chlorine Service is designed to fulfil the requirements of modern water purification and sanitation systems. This service is not only designed for quick and convenient delivery of Liquid Chlorine. It is a service system upon which State and municipal authorities can depend for adequate supplies in times of emergency... upon which they can depend for advice and technical assistance when it is required.

Solvay Liquid Chlorine shipments are now routed from Syracuse, New York; Hopewell, Virginia; and Baton Rouge, Louisiana. Your inquiries on Solvay Liquid Chlorine are cordially solicited. Please write to

**SOLVAY SALES CORPORATION**  
Alkalies and Chemical Products Manufactured by  
The Solvay Process Company  
40 RECTOR STREET NEW YORK, N. Y.



**COOK**  
Well  
Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

**A. D. COOK, INC.**  
Lawrenceburg - Indiana

**COOK**  
Deep-Well  
Turbine  
Pumps

(Continued from page viii)

#### Junior Members

GEARHART, JOHN C. Jr. Engr., Stevens & Koon, 1203 Spalding Bldg., Portland, Ore.  
PAISLEY, PETER P. Asst. Chemist, City of Toronto, 324 Markham St., Toronto, Ont., Canada.

#### Affiliates

MARTINSEN, NORMAN. Gen. Sanitation Inspector, Klickitat-Skamania Co. Health Dept., Goldendale, Wash.

#### Reinstatements (Active)

BOYKIN, H. P. Assoc. Prof. of Civil Engineering, Virginia Military Institute, Lexington, Virginia.  
HELBIG, W. A. Asst. Engineer, Darco Corporation-Sales Div. 60 East 42nd St., New York, N. Y.  
KLINE, HUBERT S. Chemist-Bacteriologist, 5 Palmer St., Dayton, Ohio.  
PURCELL, LEE T. Analyst, No. Jersey District Water Supply Commission, Wanaque, N. J.

#### Reinstatements (Associate)

H. C. NUTTING TESTING ENGINEERS, 4120 Davis Lane, Cincinnati, Ohio.

#### Deaths

BUELL, WILLIAM C. Genl. Mgr., Millville Water Co., High St., Millville, N. J.  
HANSEN, J. C. Water Works Trustee, 551 W. Broadway, Council Bluffs, Iowa.  
MORLEY, E. CARLOS. Supt. of Water, Sodus Point, N. Y.

#### Resignations (Active)

ANDERSON, G. E. Mgr., Crane Co., 201 Church St., Buffalo, N. Y.  
ANDERSON, L. M. Controller, Dept. of Water & Power, 207 So. Broadway, Los Angeles, Calif.  
FARNSWORTH, O. J. Pres., R. P. Farnsworth & Co., Inc., 212 Nashville Ave., New Orleans, La.  
MILLER, F. C. City Chemist, Trinidad, Colo.  
SPENCE, W. O. Asst. Filter Plant Operator, Sanford, N. C.  
TRASK, FRANK E. Cons. Engr., 305 Bradbury Bldg., Los Angeles, Calif.

#### Resignations (Corporate)

SEWERAGE & WATER BOARD OF NEW ORLEANS. Mr. A. Baldwin Wood, 526 Carondelet St., New Orleans, La.  
DEPT. OF WATER WORKS. Mr. William Peters, Valparaiso, Ind.



PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

## MABBS RAWHIDE PACKING

on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

Why not use it in your plant and benefit thereby?

MABBS HYDRAULIC PACKING COMPANY, Inc. 1892, 431 S. Dearborn St., Chicago, Ill.

(Continued from page 32)

**Petitions were circulated** to discontinue the operation of a water softener in New Philadelphia, Ohio, because many citizens blamed the water softener and/or a new chlorinator for the undesirable odor of the municipal water. The chlorinator was installed at the instance of the State Board of Health and officials say it is not at fault. Tests of the water have been approved by the State Board of Health, and officials have blamed a reservoir that was not cleaned for four years until this fall. Citizens still remain skeptical that leaves and other vegetable matter have drained into the mains and cause the odor.

**Political activity has been defined** and regulated for employees by the Board of Water and Power Commissioners of Los Angeles, California. The following is quoted as reported in *Intake* which is published monthly for employees of the Los Angeles City-owned Department of Water and Power:

"That until further order of the Board, the General Managers be requested and instructed, in order to effectuate the firm policy of the Department, to disseminate amongst and to enforce as to, employees

(Continued on page 36)

## WHY IS THE ACCURACY OF THE **EMPIRE** *Measuring Chamber* SUSTAINED THROUGHOUT YEARS OF SERVICE?

That the Empire is the most accurate meter ever manufactured . . . that its accuracy is sustained is not merely a manufacturer's claim, but is a fact substantiated by service records.

There are logical reasons why the accuracy of the Empire is lasting, and those reasons are found in the measuring chamber . . . in its single moving part, the Empire Balanced Piston.

Because the web of this piston is centered to equalize the pressures above and below it . . . because the piston has substantially the same specific gravity as water, it practically floats between the finished faces of the measuring chamber.

Thus friction and wear . . . the common causes of increasing inaccuracy and repeated repairs and replacements . . . are reduced to an absolute minimum . . . accuracy is assured throughout years of service.

**NATIONAL***Meters*

National Meter Company, 4207 First Avenue, Brooklyn, N. Y.  
BOSTON CHICAGO DALLAS LOS ANGELES SAN FRANCISCO

(Continued from page 35)

within their respective jurisdictions, the following Rules and Regulations respecting 'Political Activities':

'Rules and Regulations Respecting Political Activities of Employees of the Department:

"1. No employee of the Department shall engage in 'political activities' for the purpose of influencing or affecting the election of any candidate for public office of The City of Los Angeles or of the state but elected from the City or a portion thereof. 'Political activities' shall be deemed to be:

(a) Use by an employee of Department time, premises, facilities or property, including automobiles, for such purpose or to such end;

(b) Any representation by an employee, express or implied, that he is acting for or on behalf of the Department in respect of any such candidate.

"2. No employee shall be granted a leave of absence for the purpose of becoming a candidate for and seeking election to any public office of the character described in 1, nor for the purpose of assisting any candidate for such public office during his employment.

"3. It is understood that in the event of any employee resigning for any of such purposes, reinstatement shall not be recommended.

"4. Any violation of these rules shall, subject to Civil Service requirements, be deemed a cause for discharge, or lesser disciplinary action, dependent upon the seriousness of the infraction of the rule."

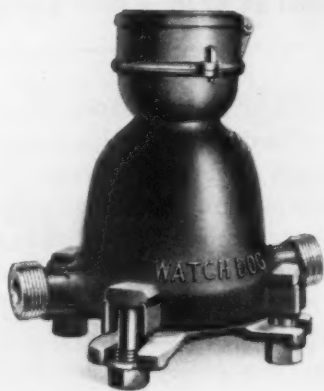
**John J. Reager**, formerly Assistant Superintendent of Water Works at Perth Amboy, N. J., has been made Superintendent and Engineer in that city.

**More than \$14,000 in the black**—is the report of the Distribution Division of the Covington, Kentucky, water works. This report was made by Lewis McDannold, superintendent of the Distribution Division and his assistant, Charles O. Davis. Under a new system inaugurated December 1, 1937, the water works was reorganized into two separate divisions: pumping and filtration, and distribution. John T. Kingsley, head of the old system, transferred his offices to the filtration plant, and Mr. McDannold was put in charge of distribution.

Under the new system, the Distribution Division was allotted \$88,942 to carry on water service through 110 miles of mains to about 15,000 customers. The actual expense is expected to average considerably more

(Continued on page 38)

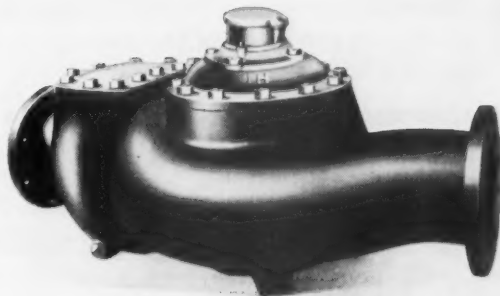
## WATCH DOG METERS



*Frost-proof  
meter*



*Turbine meter*



### *Investigate these meters*

*. . . more than 3,500,000 now in use*

WHEN looking over your requirements, remember that thousands of municipalities are getting satisfactory low-cost service from Worthington-Gamon Meters.

**WORTHINGTON-GAMON METER COMPANY**

General Offices: HARRISON, NEW JERSEY

*Offices and Representatives in Principal Cities*

## WORTHINGTON-GAMON

(Continued from page 36)

than \$1,000 per month less than the allotted amount. Revenues collected by the Distribution Division are estimated as totaling \$350,000 for the year.

**To pump and measure acids** and other clear, corrosive solutions, International Filter Co., Chicago, Ill., has developed a plunger-diaphragm type of pump. The plunger of the pump actuates a rubber diaphragm through means of a transmission liquid, and the diaphragm in turn, with a rubber pumping chamber and valves, actually handles the solution. The pump is designed to return automatically through a compensating valve mechanism any transmission liquid that slips past the piston rings.

In the event of the solution being pumped leaking past the diaphragm, it is said that the mixing of solutions would change the transmission liquid from a non-conductor to a conductor, close an electric circuit and sound a warning. The rate of chemical feed is changed by adjusting the piston stroke or by altering the speed of the motor.

**Protective coatings** of interest to the water works man were described in a paper presented by R. J. Moore of Bakelite Corp. at a meeting at Franklin Institute, Philadelphia, November 1, 1938. Parts of the paper follow:

"The way in which engineers, architects, and others in charge of operation and maintenance have battled against vexing and costly problems in corrosion makes an interesting story. Case histories illustrate the progress that has been made through the use of phenolic resins in exacting testing work. The following selection covers some special problems, and, it is hoped, will suggest methods of solving many of the other problems in protection which are still before us.

"One of the engineer's greatest corrosion problems has been the protection from corrosion of steel locks, dams, ships and other construction in river waters. This has been aggravated by acidity and dissolved salts in the water and by the erosion of flowing silt and casual foreign objects. After years of testing, the U. S. Army Engineers in charge of the twenty-six locks and dams in the Mississippi River have written specifications calling for 100 per cent phenol-formaldehyde resins, and for the past two years have used primers and aluminum finishing paints based on these specifications. Much greater protection after two years was achieved than afforded by their former coatings which lasted six months or less.

(Continued on page 40)

# THE STANDARD

for more than  
**50 YEARS**

## WATER WORKS SPECIALTIES



**Automatic Pressure Control  
Valves**

**Pressure Reducing-Altitude  
Surge-Relief and Combination  
Valves**

**Portable Fire Hydrants**

**Hydraulic Booster Pumps**

**ROSS VALVE MFG. CO., INC. TROY, N. Y.**

**THE GOLDEN GATE BRIDGE—San Francisco**  
**TRIBOROUGH BRIDGE—New York**  
**WELLAND CANAL BRIDGES—20—Canada**



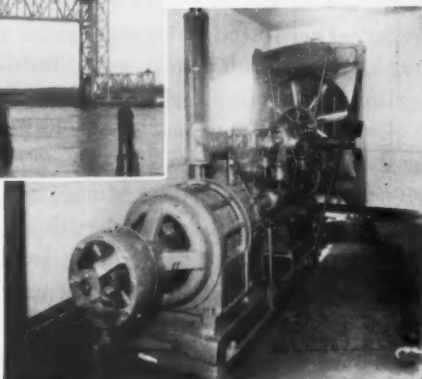
*Cape Cod Canal Bridge at Buzzards Bay, Massachusetts, project of U. S. Engineers, is equipped with 125 K.W. 1200 R.P.M. generator, driven by Sterling Dolphin C 8-cylinder gasoline engine*

The Pennsylvania Railroad Bridges, C.R.R. of N. J. Bridge, the D.L. & W. R.R. Bridges at Newark, the New York State Bridges at Albany, most all of the prominent bridges in the past 20 years have Sterling Engines, either for primary power or emergency.

*The accumulated data, covering all details required for a successful installation—yours on request.*



**Sterling  
High  
Duty  
Internal  
Combustion  
Engines**



## Sterling Engine Company

Dept. C-3  
**Home Office and Plant**  
1270 Niagara Street  
Buffalo, N. Y.

**Branch Office**  
900 Chrysler Bldg.  
New York, N. Y.

*(Continued from page 38)*

There are 26 of these dams running from St. Paul to St. Louis, consisting of tainter and roller gates, each 30 feet or so long, and running 15 to 20 in a row. The finish must stand not only occasional, but also long period, immersion in the river water, in addition to the blazing sun of summer and the ice and frost of winter on the exposed areas.

"Similar specifications are in use by the lock and dam engineers in charge of the Tennessee Valley Authority, and Chicago engineering area. The engineers of the U. S. Army Pittsburgh District recently issued a report entitled, 'Corrosion and Erosion in River and Harbor Structures' (Dieffenbach, Industrial & Engineering Chemistry, Volume 30, page 1014, 1938). In this they describe the various types of rusting and erosion problems which they face and the successful results of the efforts to combat them. They state that after considerable experimentation and research over a period of several years, the Pittsburgh Engineer District has found that paint made in accordance with the following specification is far superior to any other for the prevention of corrosion and erosion of ordinary iron and steel structures in the Monongahela River. Then follows the U. S. Engineer's specifications and formulations for anti-corrosive primers and gloss finishing paints, all based on the use of a 100 per cent phenol-formaldehyde resin which is itself rigidly specified in order to insure procurement of the highest quality. For example, the resin to be used in the vehicles for both primer and finishing coats shall be rosin-free, shall stand immersion in water, gasoline and concentrated sulfuric acid respectively for 72 hours, and shall show less than 6 per cent volatile when heated at 560°F. for 15 minutes.

"Another vexing problem of the paint industry and the engineer in the past has been the interior of steel water tanks. Dr. H. A. Gardner, Director of the Scientific Section of the Paint & Varnish Manufacturers Association stated some eight years ago that if a successful coating for such tanks were developed, it would open up an annual market of over a million gallons.

"This problem has largely been solved through the use of the water-resistant finishing system somewhat similar to those just described. In 1934 the Pittsburgh-Des Moines Steel Co. conducted a test of 196 different paints on the inside of a million-gallon steel water tank. Each month the tank was emptied and two inspectors made independent reports. At the end of 18 months the test was discontinued and their Technical Report #3301 issued. This stated that the only finish rating 100 per cent in this test was based on Bakelite synthetic resin.' "

## **June and Atlantic City are**

### **Just Around the Corner**

See pages 26, 27, 28, and 29 for Technical Program.

See pages 2 and 4 for Entertainment Events.

See pages 8, 10, 14, 15, 22, 30, and 32 for transportation information.

We have just listened to Chairman "Bill" Orchard's enthusiastic story of Atlantic City's elaborate preparations for the 59th Annual Meeting,—to John Warde's plans for transporting you to and from there to here and back again,—to Clint Inglee's elaborate program for a week of entertainment such as only the World's Playground can offer,—to J. Herman Smith's report of the biggest preconvention sale of exhibit space in the history of the Association.

"Biggest and Best Ever"—that's the story and that is just what you can expect from the Association's past history. Each Annual Meeting outstrips its predecessors and no matter how often it seems as though we must have reached the "peak of perfection" each succeeding year outdoes all others—and Atlantic City is going to be "tops."

### **Convention Hotel Arrangements**

Two hotels, the Ambassador and the Chelsea—so close to each other that you step from one lobby into the next—have been selected for Headquarters and together they are holding 900 rooms—accommodations for from 1300 to 1500 guests—for us. See hotel rates on page 6.

### **Exhibits**

All that is new in water works equipment and materials will be on display. Practices and methods are changing so rapidly that only by viewing this great exhibit can you keep abreast of what is new in design, construction and operation of water works equipment—and see the result of development, research and use of new materials.

This year a radical departure is being tried out in holding the display of exhibits and all technical sessions in the Atlantic City Auditorium.

As a consequence much more space will be available for exhibit display than ever before and manufacturers will be able to show much more extensively all the things they have been prevented from showing at other conventions through lack of space.

*(Continued on page 2)*

(Continued from page 1)

**Entertainment and Social Activities**

Consider this combination—the A. W. W. A. Entertainment Committee and all the resources of America's Playground, Atlantic City. That's an unbeatable combination. It's a "never a dull moment program" if ever there was one.

**Water Works "Get Together"**

Sunday, June 11—8:30 p.m.

*Music Room, Hotel Chelsea*

Since the special trains reach Atlantic City on Sunday morning and the exhibits open that day, many members will enjoy an informal evening hour together. Music and motion pictures of the New Orleans convention will help all get acquainted.

**President's Reception and Dance**

Monday, June 12—9:00 p.m.

*Renaissance Room, Hotel Ambassador*

This informal event gives an opportunity for all members to meet the Association's president and president-elect; to make new acquaintances and to renew old ones. Tickets for this feature are included with the \$5.00 and \$6.00 registration fee. Separate tickets may be purchased at \$1.00 each.

**Ladies' Sightseeing Tour**

Tuesday, June 13—2:00 p.m.

A ride in Atlantic City's typical wheel chairs from the headquarters hotels clear to the north end of the boardwalk. Then at the world-famous Hackney's Restaurant, a collation will be served. Chairs will return the ladies to the hotels. Tickets are included with the \$5.00 registration fee. Separate tickets may be purchased at \$2.00 each.

**All Section Dinner**

Tuesday, June 13—7:00 p.m.

*Westminster Room, Hotel Chelsea*

Bill Orchard will greet all and make the diners sing their favorite songs. An award will be made to the Section having the best attendance—computed in terms of member-mileage.

A new award, "The Old Oaken Bucket," will go to the Section having the largest total membership on the first of June.

A floor show by New York's best professional entertainers will follow the dinner.

Tickets are \$2.50 each, not included with registration. *Please help by purchasing your tickets before noon on Tuesday.*

**Division Luncheons**

Wednesday, June 14—12:30 p.m.

*Hotel Ambassador*

The Finance and Accounting Division and the Water Purification Division will each hold its annual get-together shop-talk luncheon at the close of

(Continued on page 4)

## PIPE GIVES CITY \$100,000 ON 21ST BIRTHDAY

**1917** This is the story of an event in the life of a cast iron water main installed by the City of Springfield, Ill. in 1917. It was originally a 24-inch force main to bring water from the Sangamon River five miles away, which function it performed satisfactorily for 21 years.

**A new source** of water supply was developed, making the 21-year-old cast iron main unnecessary. It was inspected and approved for use elsewhere.

**1938** Last year they re-laid this old cast iron pipe on its 21st birthday, saving the City \$100,000 over the cost of new pipe. Every length was in perfect condition for a century or more of additional service.

**HIGH SALVAGE value is one of the three major economies of cast iron pipe, of which many cities have taken advantage. The greatest saving, justifying cast iron pipe's reputation as Public Tax Saver No. 1, results, of course, from long life and low maintenance cost.**



Look for the "Q-Check" registered trade mark.  
Cast iron pipe is made in diameters from 1½ to 84 inches.

The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago

# CAST IRON PIPE

## PUBLIC TAX SAVER NO. 1

(Continued from page 2)

the Wednesday morning sessions. The afternoon is free and the feast of reason can continue without limit. Tickets at \$1.00 each—must be purchased at the general registration desk.

**Golf Tournament**

Wednesday and Thursday, June 14-15

*Seaview Golf Club*

Karl Mann has arranged the tournament so that the golfers may choose either Wednesday or Thursday for their play. No technical sessions are scheduled for Wednesday afternoon and the industrious conventioneer may play at that time and thus miss none of the papers. The Seaview course is world-famous and no devotee of golf can afford to miss playing it. Greens fee, \$3.00. Players pay their own caddies. Special transportation will be available. Twenty-four prizes have been provided. Play for prizes limited to registered attendants at the convention.

**Monte Carlo**

Wednesday, June 14—8:30 p.m.

*Westminster Room, Hotel Chelsea*

An evening of games of chance with *water works money* furnished will be the diversion on this evening. Prizes will be given to the holders of the most of the imitation money at the close of the evening. Tickets are included with the \$5.00 or \$6.00 registration fee. Separate tickets may be purchased at \$1.00 each.

**Ladies Luncheon Bridge**

Thursday noon, June 15.

*Seaview Golf Club*

A luncheon and bridge party will be held at the Seaview Golf Club with prizes for the high scorers. The club house is one of the show places of Atlantic City and the event should interest every lady who attends. Tickets are included with \$5.00 registration. The price of separate tickets is \$2.00.

**Dinner and Dance**

Thursday, June 15—7 p.m.

*Dinner—Westminster Room, Hotel Chelsea**Dance—Renaissance Room, Hotel Ambassador*

The dinner will be held in the Hotel Chelsea and is the climax of the convention. Formal dress is not necessary. After the dinner, the Association's annual honorary awards will be presented. The speeches will be as short as the value of the ceremony makes possible.

After the presentations, the guests will go just across the street to the Ambassador for the dance. Tickets for this event are included with the \$5.00 or \$6.00 registration. Separate tickets may be purchased for \$3.00 each.

*Table reservations* (seating 6, 10 or 12) may be made at the general registration desk after 9:00 a.m. Wednesday. It is required, however, that persons making the reservations bring the dinner tickets for the persons desiring the reservations to the registration desk, where they will be marked to indicate the table to be occupied.



## **WORTHINGTON EQUIPMENT FOR WATER SUPPLY**

**CENTRIFUGAL PUMPS**

**STEAM AND POWER PUMPS**

**DEEP WELL TURBINE PUMPS**

**SUMP AND DRAINAGE PUMPS**

**DIESEL ENGINES**

**GAS ENGINES**

**STEAM CONDENSERS**

**CONDENSER AUXILIARIES**

**FEEDWATER HEATERS**

**STEAM-JET EJECTORS**

**STATIONARY AIR COMPRESSORS**

**PORTABLE AIR COMPRESSORS**

**ROCK DRILLING EQUIPMENT**

**CONSTRUCTION AIR TOOLS**

**V-BELT DRIVES**

**AIR LIFTS**

**STEAM TURBINES**

**REDUCING AND INCREASING GEARS**



### **WATER METERS**

A complete line of water meters of every type is manufactured by Worthington-Gamon Meter Company, a subsidiary of Worthington Pump and Machinery Corporation.

● *Descriptive literature on any of these products furnished on request*

**WORTHINGTON PUMP AND MACHINERY CORPORATION  
WORTHINGTON-GAMON METER COMPANY**

General Offices: **HARRISON, NEW JERSEY** District Offices and Representatives in Principal Cities

**Schedule  
of the  
A. W. W. A. Special**

Through Pullman service with berth and room accommodations, also dining car service, to the Atlantic City Convention (no change of cars at North Philadelphia) via Pennsylvania Railroad from Chicago, St. Louis, Cincinnati, Cleveland, Pittsburgh and other points enroute, is shown below:

**Saturday, June 10:**

Lv. Chicago—Pennsylvania Railroad.....	1.30 P.M.
Lv. Fort Wayne.....	4.00 P.M.
Lv. Mansfield.....	7.39 P.M.
Lv. St. Louis—Pennsylvania Railroad.....	9.20 A.M.
Lv. Indianapolis.....	1.59 P.M.
Lv. Dayton.....	5.10 P.M.
Lv. Columbus.....	6.44 P.M.
Lv. Cincinnati—Pennsylvania Railroad.....	4.30 P.M.
Lv. Columbus.....	7.16 P.M.
Lv. Cleveland—Pennsylvania Railroad.....	8.15 P.M.
Lv. Hudson.....	8.55 P.M.
Lv. Pittsburgh—Pennsylvania Railroad.....	11.45 P.M.

**Sunday, June 11:**

Ar. Atlantic City.....	9.15 A.M., E.S.T.
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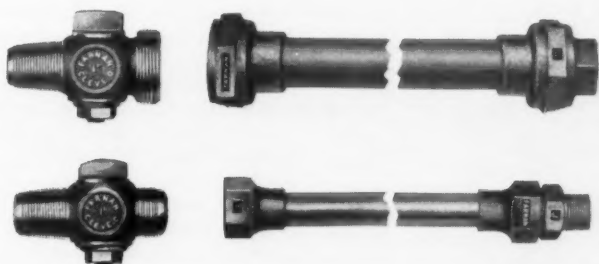
Members west of Chicago and St. Louis, and south of Cincinnati will have the choice of traveling via any railroad to join special through service to Atlantic City from any of the above Pennsylvania Railroad terminal points. The passenger and ticket agent in your home town, or any member of the A. W. W. A. Transportation Committee in or located near your city which is listed in this folder, will be happy to assist you in securing reservations desired to Atlantic City and to complete your ticketing arrangements. A Pullman reservation blank is given on page 32 for your convenience.

(Continued on page 10)

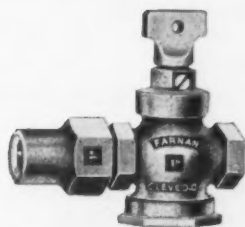
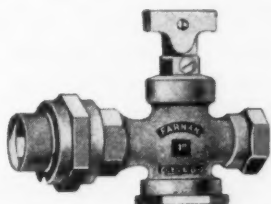
# FARNAN AND WIDE

*is known for its*

**DEPENDABLE  
WATERWORKS  
INSTALLATIONS**



MEMBER OF  
A. W. W. A.  
SINCE 1892



TESTED AT  
200 \* HYDROSTATIC  
PRESSURE

**THE FARNAN BRASS WORKS CO.**  
**CLEVELAND**      *ESTABLISHED 1852*      **OHIO**

(Continued from page 8)

The following table gives a few departing schedules without extra fares to reach Chicago, St. Louis and Cincinnati to connect with special through service to the Convention City:

LEAVE:		ARRIVE:
June 7—Seattle . . . . .	9.30 P.M.	June 10—Chicago . . . . A.M.
June 8—Spokane . . . . .	8.00 A.M.	Chicago . . . . A.M.
June 9—St. Paul . . . . .	10.55 P.M.	Chicago . . . . A.M.
June 7—Portland . . . . .	9.35 P.M.	June 10—Chicago . . . . A.M.
June 7—Los Angeles . . . . .	8.00 P.M.	Chicago . . . . A.M.
June 8—Salt Lake City . . . . .	6.35 P.M.	Chicago . . . . A.M.
June 9—Omaha . . . . .	8.00 P.M.	Chicago . . . . A.M.
June 7—San Francisco . . . . .	8.35 P.M.	June 10—Chicago . . . . A.M.
June 7—Los Angeles . . . . .	8.00 P.M.	June 10—St. Louis . . . A.M.
June 8—El Paso . . . . .	9.00 P.M.	St. Louis . . . A.M.
June 9—Dallas . . . . .	4.00 P.M.	St. Louis . . . A.M.
June 9—Houston . . . . .	12.30 Noon	St. Louis . . . A.M.
June 9—San Antonio . . . . .	9.00 A.M.	St. Louis . . . A.M.
June 9—Denver . . . . .	4.00 P.M.	June 10—Chicago . . . . A.M.
June 9—New Orleans . . . . .	8.45 A.M.	June 10—Cincinnati . . Noon
June 9—Birmingham . . . . .	9.00 P.M.	Cincinnati . . Noon
June 10—Louisville . . . . .	7.25 A.M.	Cincinnati . . Noon
June 9—Memphis . . . . .	9.15 P.M.	Cincinnati . . Noon

Eastern members, including New York City and New Jersey, will use train leaving New York Pennsylvania Station at 9:15 A.M., E.S.T., Sunday, June 11th. Special parlor cars and coaches will be provided for their comfort, to arrive Atlantic City at 12:10 Noon, E.S.T. Application for reservations should be addressed—in New England to Mr. A. D. Shaw, 1300 Statler Building, Boston; in New York and New Jersey to Mr. John S. Warde, 50 Church Street, New York City.

(Continued on page 14)



IF YOU'RE FAR-SIGHTED . . .  
YOU'RE LOOKING FOR

## NON-CORROSIVE PIPE LINES

Fortunately, in these modern times, you haven't far to look for pressure pipe that is non-corrosive, and non-tuberculating and electrolysis-proof in addition. Asbestos-Cement pipe is saving thousands of dollars annually for many a water works by eliminating these costly and familiar pipe diseases. Maintenance costs are drastically cut, as well as pumping costs and pipe replacements.

With the introduction of "Century" Asbestos-Cement Pressure Pipe, you can get these advantages in a pipe that has exceedingly high and uniform strength, insuring unusually long service life. Each length must pass a series of searching tests before it is released for shipment. Providing further economies, this

pipe is easily handled and laid because of its light weight.

"Century" Asbestos-Cement Pipe is a product of the Keasbey & Mattison Company, pioneers in the development of Asbestos and Asbestos-Cement products. It is produced by a remarkable new manufacturing process which produces an exceptionally strong and uniform pipe.

**FREE** "Mains without Maintenance," the new catalogue on "Century" Asbestos-Cement Pipe. Get all the facts.

See K & M's Fiery Snowman and Exhibit in the Home Building Center at the N. Y. World's Fair.



**KEASBEY & MATTISON COMPANY**  
AMBLER, PENNA.

District Sales Offices in Principal Cities

*Mail this coupon*

KEASBEY & MATTISON COMPANY, Ambler, Penna.

Send me, without obligation, free catalogue on "Century" Asbestos-Cement Pressure Pipe—"Mains without Maintenance."

NAME \_\_\_\_\_

NAME OF PLANT \_\_\_\_\_

ADDRESS \_\_\_\_\_

JAWWA-3

## New Materials and Gadgets

1. **A Non-Abrasive** liquid has been developed to wipe onto enamelled, varnished, or old glossy surfaces to prepare them for painting without sanding. It removes wax and grease and creates a tack to which the new paint can readily adhere.

2. **Pipe Cutting and Threading** can now be done by the use of a new compact power unit which utilizes hand tools. Designed for either bench or stand use, it is powered by an electric motor and threads pipe from  $\frac{1}{8}$  to 2 in.

3. **A New Method** for fastening high-strength cap screws and studs into light alloys employs a bronze spring wire insert for threads.

4. **A Sealing Compound** that will not stick to the hands or tools has been put on the market. Used either for glazing or as a caulking compound, it is said to be watertight, fume-proof and acid-resistant.

5. **A New Edger**, that clamps on a table, quickly mounts a narrow opaque white tape for protecting the edges of tracing, etc. Heat from blue-printing machines will not affect the adhesive.

6. **Rusted Ferrous Surfaces** can now be prepared for painting by means of a new chemical solution which is applied with a sponge or steel wool. It converts the rust into an iron salt which forms a good base for the paint.

7. **A Portable Floodlight** for use in emergency repair work has been designed to operate from a small 26 A.H. storage battery which is sealed in a case to prevent fumes. It gives maximum light for 6 hr. and can be recharged by an automobile without removal of its case.

8. **A Non-Magnetic Telephone** has been developed which, although it looks like the usual telephone, operates on a different principle: the voice energizes metallic salt crystals which set up a current to energize crystals and reproduce the voice with high fidelity at the receiving end.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items and citing the May issue as the source.

## WHAT TO DEMAND OF A

*Hydrant... and a Valve*

● **Quick Water** with least possible shock. Proper shut-off without water hammer.

● **Proper Drainage.** Hydrant automatically drained at *lowest* point when closed.

● **No Flooding.** Accidental breaking of the hydrant, such as might result by collision from a heavy truck, will not cause flood since the gate when closed is wedge-locked.

● **Easy Inspection and Servicing** without unscrewing anything below the ground level. All working parts removed as one unit by lifting stem through top of hydrant.

Only the slide gate principle provides *all* these advantages. This principle, developed and perfected by Ludlow, has been the universally accepted construction in all *water works valves* for nearly three-quarters of a century. It likewise insures **complete security** in fire hydrants.

Full information free on request.

● **Smooth, Positive Operation.** Gates positioned *directly* opposite ports before wedging, and entirely unwedged *before* being raised.

● **Positive Closure**—even after years of service in the open position; flexible-action gates *self-adjusting* to seats.

● **Self-Cleaning.** Rings cleaned *throughout entire stroke*. No *internal guides* to cause foul-up.

● **Ready Replacement of Parts.** Simple construction with ample tolerances, permitting ready replacement of parts.

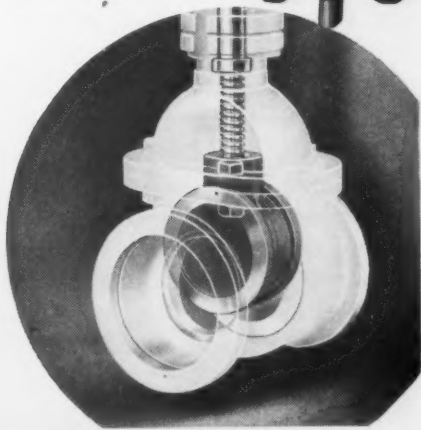
Only the parallel seat, double wedge type slide gate valve provides *all* these essential benefits. This principle, developed and perfected by Ludlow, has been the universally accepted construction in all water works valves for nearly three-quarters of a century.

**LUDLOW PRINCIPLE**  
Self-releasing 30° angle wedges and flexible action gates self-adjusting to seats for improved performance, longer life.

Full information free on request.



Notice the sound engineering of the wedge-lock principle, and its simple, sturdy construction.



*The*  
**LUDLOW**  
SINCE 1866  
**VALVE MFG. CO.**  
TROY · N.Y.

Experienced water works men call this the "most flexible" valve. Many years of trouble-free service have proved unmatched superiority.

(Continued from page 10)

The following reduced railroad fares will apply to the New York World's Fair via Atlantic City and will be in effect for the A. W. W. A. Convention. The pullman fares are one-way only and direct to Atlantic City.

FROM	ROUND-TRIP RAILROAD FARES			LOWER BIRTH	UPPER BIRTH	COMPART- MENT 2 PERSONS	DRAWING- ROOM 2 OR MORE
	(\$)	(%)	(x)				
Seattle.....			139.15	22.85	17.40	64.05	80.85
San Francisco.....			139.15	22.85	17.40	64.05	80.85
Los Angeles.....			139.15	22.85	17.40	64.05	80.85
Salt Lake City.....			111.80	17.10	13.00	47.80	59.85
Denver.....			95.50	13.95	10.60	39.40	49.35
El Paso.....			112.05	17.10	13.00	47.80	59.85
Omaha.....			74.90	9.45	7.20	26.80	33.60
St. Paul.....			70.30	8.95	6.80	25.20	31.50
Kansas City.....			72.70	9.45	7.20	26.80	33.60
Dallas.....			84.35	12.35	9.40	34.65	44.10
St. Louis.....			60.15	7.65	5.80	21.55	27.30
Chicago.....			52.45	6.30	4.80	17.85	22.05
New Orleans via Washington.....			71.30	Sleeper service to Phila.,	thence parlor car.	28.90	36.75
New Orleans via Cincinnati.....			61.95	Sleeper to Philadelphia	thence parlor car.	25.20	31.50
Memphis via Washington.....			61.95	8.95	6.80	25.20	31.50
Cincinnati.....			44.80	5.25	4.00	14.70	18.90
Detroit.....			41.30	4.50	3.40	12.60	15.75
Cleveland.....			35.70	3.95	3.00	11.05	14.70
Buffalo.....			26.35	Sleeper service to Phila.,	thence parlor car.		
Pittsburgh.....			24.05	3.15	2.40	8.95	11.55
Jacksonville.....			28.60	Sleeper service to Phila.,	thence parlor car.		
Washington.....			54.60	Parlor car seat \$1.05			
Boston.....			16.95	Parlor car seat 1.85			
New York.....			22.60	Parlor car seat .80			
			7.00 (&)				

Corresponding rates will apply from other points.

NOTES: (\*) World's Fair roundtrip coach rate to New York and regular coach fare, New York to Atlantic City and return.

(&amp;) When occupying lower birth or any type of room accommodations.

(&amp;) When occupying upper birth accommodations.

Return limit 10 days.

Return limit 30 days.

Diverse route on the return trip may be selected when purchasing ticket. From all other points tickets at these fares must be routed via the same railroad

in both directions.

(Continued on page 15)

(Continued from page 14)

### Special Tickets and Arrangements

There are intermediate class tickets on sale at lower fares than shown herein at Pacific Coast points, for use in tourist sleepers to Chicago or St. Louis, thence to New York in standard Pullman. Consult your local railroad agent for full particulars.

A special roundtrip fare of \$138.00, valid in standard Pullman cars upon payment of regular Pullman Company charges may be purchased at your home town to visit Atlantic City, New York and San Francisco.

There are also reduced roundtrip coach fares to New York World's Fair via Atlantic City and your ticket agent will furnish you information in connection therewith.

Those who are going to attend the Convention and not the World's Fair should purchase tickets to Atlantic City only, to which point Summer Excursion fares will apply, and your local ticket agent will furnish you rates accordingly.

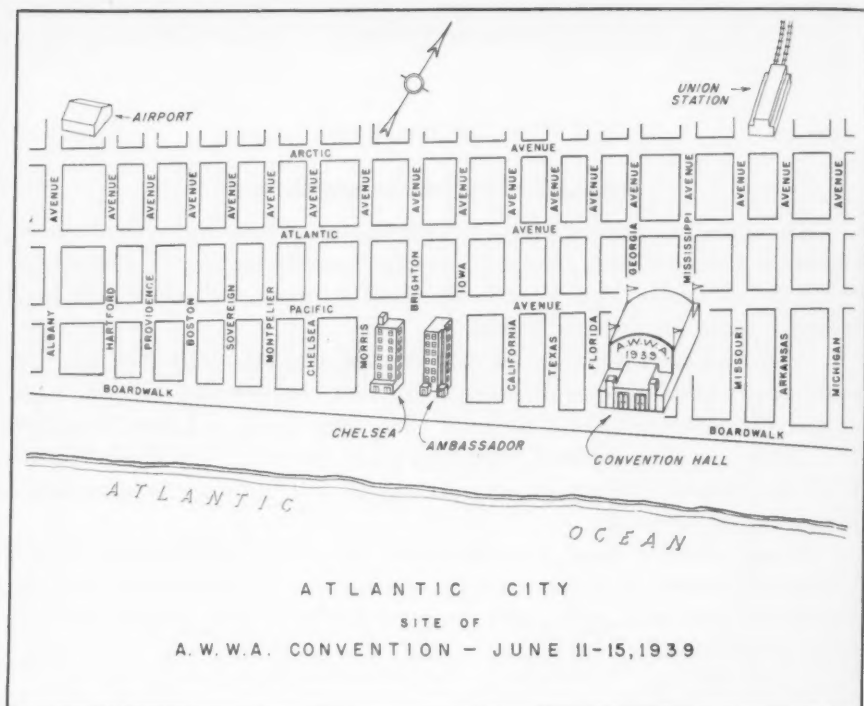
### After the Convention

#### Visit the New York World's Fair

*Friday, June, 16th:*

A special train of Pullman cars and coaches will leave Atlantic City at 8:20 A.M., E.S.T., and arrive New York Pennsylvania Station—opposite the Hotel Pennsylvania—at 11:45 A.M., E.S.T.

The A. W. W. A. Committee has made definite room reservations for members, their families and friends at the Hotel Pennsylvania to accommodate 225 members, beginning June 16th. Members will please write **direct to Mr. Donald M. Mumford**, Sales Manager, Hotel Pennsylvania, New York, N. Y., for reservations desired, specifying price of room preferred. Daily rates, without meals, are from \$3.50 to \$5.00 for single rooms; \$5.00 to \$8.00 for double rooms; and \$6.00 to \$9.00 for twin bedded rooms. Mr. Mumford will acknowledge your application immediately. It is important that you make application early.



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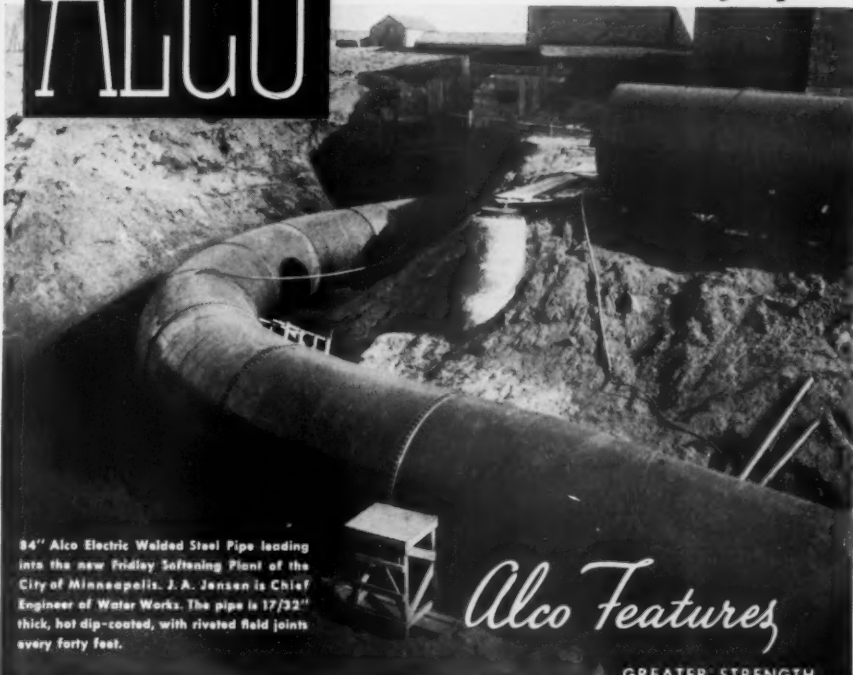
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(Continued from page viii)

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DEPTS. OF WATER, FIRE & SANITATION. Mr. Al. Blaylock, Commissioner, City Hall, Baker, Ore.  
TOWN OF BELLE BLADE WATER WORKS. Mr. F. W. Kelley, Supt., Belle Glade, Fla.  
CANTON MUNICIPAL UTILITIES. Water Works Dept., Mr. W. M. Reid, P. O. Box 114, Canton, Miss.

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*Affiliates.*

BOULWARE, C. E. Supt., Mun. Water Works, Markle, Ind.  
BOW, WILSON F. San. Engr., Whatcom County Health Dept., Court House, Bellingham, Wash.

*Reinstatements (Active)*

BADLEY, HARRY W. Repr., Neptune Meter Co., 969 Highland St., Salina, Kan.  
CAMPBELL, ARCHIE E. Supt. of Water Dept., 136-13th St., Cloquet, Minn.  
CLARK, S. C. Supt. of Water Properties, Central Light & Power Co., San Benito, Texas.  
LEVINE, MAX. Prof. in Charge, Dept. of Bacteriology, Iowa State College, Ames, Iowa.  
LUTHER, ROBERT W. Plant Supt., Public Utility Comm., Box 56, Elizabeth City, N. C.

(Continued on page 20)

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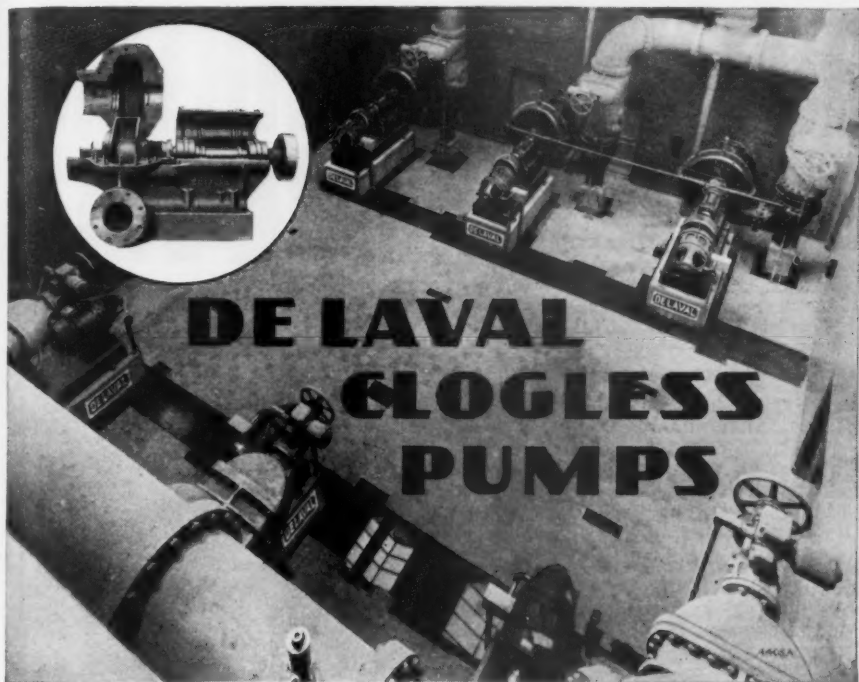
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*Guaranteed to save its cost  
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**I**N the new Easterly Sewage Pumping Station, the City of Cleveland has installed six *DE LAVAL CLOGLESS PUMPS* driven by gear motors. These have capacities of 15,000,000 gal. per day each against 15 ft. head at 294 r.p.m. The motor speed is 1160 r.p.m.

De Laval Clogless Pumps were selected by reason of their excellent record and the following facts:

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The enclosed impeller combines high efficiency and long life when pumping gritty liquids.

Wearing rings protect both the impeller and the casing at the joint separating suction from discharge space. This joint can be sealed with clear water, as also the stuffing box.

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Pump casing is cast integrally with, or firmly bolted to, the bearing pedestal to insure alignment.

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AND FLEXIBLE COUPLINGS—SOLE LICENSEES OF THE BAUER-WACH EXHAUST PUMPING SYSTEM

(Continued from page 18)

TRAVER, LESLIE J. Supt. of Pumping Plant, East Bay Municipal District, 512-16th Street, Oakland, Calif.

*Resignations (Active)*

HARVEY, L. R. Salesman, Johns-Manville Corp., 448 West 24th Ave., Spokane, Wash.

MOWER, CHARLES M., JR. 256 S. Collingwood Ave., Syracuse, N. Y.

PEARSON, CHARLES DEARNE. Shanghai Waterworks Co., Ltd., Thames House, Queen St. Place, London, E.C.4, England.

STRANGE, E. L. Mgr., City Water Works, Corvallis, Ore.

WALTER, FRED. Maintenance Foreman, Filtration Plant Water Board, 5234 Somerset St., Detroit, Mich.

*Deaths*

BERGSTROM, JOHN. Civil Engr., Kungsbrolauh, Stockholm, Sweden.

BIELOT, ARTHUR. Jr. Sanitary Chemist, Water Works Filtration Plant, Detroit, Mich.

CUDDEBACK, ALLEN W. Federal Water Service Corp., 90 Broad St., New York, N. Y.

ELDRIDGE, H. D. Treas., Princeton Water Co., Princeton, N. J.

*Transfers Between Sections*

ALBERT E. HARGETT, from New Jersey to Kentucky-Tennessee.

C. W. STEWART, JR., from Indiana to West Virginia.

JAMES R. COOK, from West Virginia to Four States.

M. LeBosquet, Jr., from Illinois to Ohio.

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April .....	1936
January .....	1937
March .....	1937
January .....	1938

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American Water Works Association  
22 East 40th St., New York

# MATHIESON *HTH* FOR SAFE BEACHES



**MATHIESON CHLORINE  
FOR SAFE DRINKING WATER**



Says George R. Young, Village Manager,  
Village of Glencoe, Illinois:

March 7, 1939

"You will be interested in our successful use of HTH on our Lake Michigan Beach. . . Two problems were involved: foot infections from the bacteria in the sand, and insects. . . HTH was tried, using a 2% solution. We were able with this solution sprayed on the sand to reduce the fly egg count from 800 per square inch to almost none. We eliminated bacteria and foot infection completely, so far as we were able to determine. We feel that the added satisfaction and confidence inspired in our Glencoe residents who use the beach was well worth while. . . In the past ten years we have enjoyed excellent service from your company."

- Municipal Bathing Beach, Glencoe, Illinois.
- Filtration Plant Glencoe, Illinois Waterworks.

HTH is a dry, free-flowing chlorine carrier. 70% of its weight is chlorine available for killing bacteria and destroying odors and other objectionable contamination. Its germ-killing power is released rapidly, uniformly — requires no bulky equipment, no specially expert or experienced operator. Best of all HTH really does the job.

Glencoe is only one of the many villages, towns and great cities throughout the country that have found in HTH and Mathieson Chlorine the ideal solution of the problem of water purification, sewage treatment, beach and pool sanitation.

Mathieson Chlorine means a pure, dependable product — safe, trouble-free containers and valves — prompt delivery service. In addition you have available the full cooperation of Mathieson's expert technical staff.

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THAD M. ERWIN, Sales Agent, Dept. of Water & Power, 207 So. Broadway, Los Angeles, Calif.

ROBERT W. HARDING, Manager, Bexar County Water Co., South San Antonio, Texas.

N. T. VEATCH, JR., Cons. Engr., 4706 Broadway, Kansas City, Mo.

JOHN C. DETWEILER, Constr. Engr., Metropolitan Utilities, Dist. Omaha, Nebr.

L. N. THOMPSON, Gen'l Supt. Water Dept., 216 Court House, St. Paul, Minn.

W. C. LAWRENCE, Commissioner, Water & Heat, Dept. Public Utilities, Cleveland, Ohio.

L. S. VANCE, Chief Engr. & Supt., Louisville Water Co., Louisville, Ky.

C. M. McCORD, Gen'l Supt., Light & Water Division, Memphis, Tenn.

CYRUS R. BIRD, Pitometer Co., 704 Stephenson Bldg., Detroit, Mich.

CHAS. E. RICHHEIMER, Cons. Engr. 1604 Lynch Bldg., Jacksonville, Fla.

J. O. MEADOWS, San Engr., J. T. Donald & Co., 1181 Guy St., Montreal, Can.

NORMAN J. HOWARD, Dir. of Water Purif., 410 Lake Shore, Centre Island, Toronto, Ont.


JOSEPH E. LYLES, Chemical Engr., Filtration Plant, Tampa, Florida.

W. H. WEIR, State Board of Health, State Capitol Bldg., Atlanta, Ga.

J. E. O'LEARY, Pittsburgh Des Moines Steel Co., Neville Island, Pittsburgh, Pa.

EUGENE F. DUGGER, Gen'l Mgr. Newport News Water Commission, Newport News, Va.

(Continued on page 30)



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NEW YORK CITY

**PROGRAM—MONDAY MORNING****GENERAL SESSION**

- 9:30 **Announcements**  
 9:40 **President's Address**  
       REEVES NEWSOM, New York, N. Y.  
 10:00 **Social Security for Water Works Men**  
       DALE L. MAFFITT, Des Moines, Iowa.  
       Discussion—W. W. BRUSH, New York, N. Y.  
 10:30 **Progress in Electrical Grounding Research**  
       C. F. MEYERHERM, New York, N. Y.  
       Discussion—G. A. SAMPSON, Boston, Mass.  
 11:00 **Labor Relations in the Water Works Plant**  
       LEO WOLMAN, New York, N. Y.  
       Open Discussion  
 11:45 **Discussion: The New Law of Design for Cast Iron Pipe**  
       Led by W. D. MOORE, Birmingham, Ala.

**MONDAY AFTERNOON****PLANT MANAGEMENT & OPERATION DIVISION**

- 2:00 **Wholesale Cost of Water**  
       C. H. CAPEN, JR., West Orange, N. J.  
 2:30 **Water Quality Complaints and Their Interpretation**  
       W. C. LAWRENCE, Cleveland, Ohio.  
 2:50 **Potential Health Hazards in the Distribution of Water to Consumers**  
       ARTHUR E. GORMAN, Chicago, Ill.  
 3:20 **A Safety Code for Water Distribution**  
       WM. E. STANLEY, Ithaca, N. Y.  
 4:00 **Maintaining Proper Charges for Private Fire Protection**  
       D. D. GROSS, Denver, Colorado.  
       Discussion—JOHN B. WINDER, Dallas, Texas.

**PURIFICATION DIVISION**

- 2:00 **Committee Reports**  
 2:00 **Methods of Determining Fluorides**  
       PR. F. A. P. BLACK, *Chairman*, Gainesville, Fla.  
 2:30 **Specifications and Tests for Water Purification Chemicals**  
       PROF. M. M. BRAIDECHE, *Chairman*, Cleveland, Ohio.  
 3:00 **Testing of Zeolites**  
       CHARLES P. HOOVER, *Chairman*, Columbus, Ohio.  
 3:30 **Progress Reports**  
       High Rate Treatment  
       NORMAN J. HOWARD, Toronto, Canada.  
       Conditioning Methods to Inhibit Corrosion—PROF. W. F. LANGELIER, Berkeley, Calif.  
       Activated Carbon Research—PROF. M. M. BRAIDECHE, Cleveland, Ohio.  
       Coordination of Methods of Water Treatment and Laboratory Control—GEO. D. NORCOM, New York, N. Y.  
 3:45 **The Aging of Reservoir Waters**  
       LEE T. PURCELL, Wanaque, N. J.  
       Discussion—ARTHUR H. PRATT, Newark, N. J.  
       ROBERT SPURR WESTON, Boston, Mass.  
 4:15 **An Iodide Technic for the Colorimetric Determination of Chlorine in Water**  
       F. W. GILCREAS, Albany, N. Y.  
       Discussion—GEORGE E. WILLCOMB, Albany, N. Y.

**PROGRAM—TUESDAY MORNING****GENERAL SESSION**

- 9:30 **Basic Principles in the Design and Operation of Earth Dams**  
WM. P. CREAGER, Buffalo, N. Y.  
Discussion—FRANK A. BARBOUR, Boston, Mass.
- 10:15 **Recovering from the Recovery Program**  
CARL H. CHATTERS, Chicago, Ill.  
Discussion—ABEL WOLMAN, Baltimore, Md.
- 11:00 **The Importance of a State's Water Resources**  
HON. A. HARRY MOORE, Trenton, N. J.
- 11:45 **New Jersey's Peculiar Problem**  
GEORGE S. BURGESS, Trenton, N. J.

**PURIFICATION DIVISION**

- 9:30 **Fundamentals of Water Pre-Treatment**  
F. M. BACHMANN, New York, N. Y.  
Discussion led by ROBERT W. FURMAN, Toledo, Ohio.
- 10:15 **Experiences with the Coagulation of Soft, Colored Water by Ferric Sulfate**  
GEO. E. WILLCOB, Albany, N. Y.  
Discussion led by ELWOOD BEAN, Cranston, R. I.  
A. H. ULLRICH, Fort Smith, Ark.
- 11:00 **Illinois's Experiences in Lime Softening with Short Time Upward Flow Clarification**  
C. W. KLASSEN, and  
H. A. SPAFFORD, Springfield, Ill.
- 11:45 **Performance of Upward Flow Basins at St. Petersburg, Florida**  
R. W. SAWYER, New York, N. Y.  
Open discussion

**TUESDAY AFTERNOON****GENERAL SESSION**

- 2:00 **Methods for Determining Water Hammer Pressure**  
F. M. DAWSON and  
A. A. KALINSKE, Iowa City, Iowa.
- 2:20 **Water Hammer Studies on Long Pipe Lines**  
L. E. GOIT, Los Angeles, Calif.
- 2:45 **Water Hammer Control by Proper Valve Installation**  
E. C. BRISBANE, York, Pa.
- 3:10 **Open Discussion of the three preceding papers**
- 3:30 **Vertical Pump Applications**  
JULE H. COFFEY, Pomona, Calif.
- 4:00 **Round Table—Specifications for Deep Wells and Deep Well Pumps—Led by—**JAMES C. HARDING, New York, N. Y. and J. ARTHUR CARR, Ridgewood, N. J.

**FINANCE AND ACCOUNTING DIVISION**

- 2:00 **Symposium on the Activities of the National Association of Railroad and Utilities Commissioners**
- 2:00 **Standard Methods of Filing Rate Schedules**  
M. F. HOFFMAN, Cincinnati, Ohio.
- 2:40 **Standard Classification of Accounts and Standard List of Retirement Units**  
LOUIS D. BLUM, New York, N. Y.
- 3:15 **Commission Jurisdiction over Water Works**  
JACOB SCHWARTZ, Newark, N. J.
- 4:00 **Round Table—The Accounting Manual**  
Leader—BOYD BENNETT, New York, N. Y.

### WEDNESDAY MORNING

#### GENERAL SESSION ON MANAGEMENT AND ACCOUNTING

- 9:30 **Service Lives of Water Mains as Indicated by a 75 Year Retirement Record**  
REEVES NEWSOM and  
E. H. ALDRICH, New York, N. Y.
- 9:50 **Inspection Methods for Determining Pipe Condition**  
K. H. LOGAN and  
E. A. KOENIG, Washington, D. C.  
Discussion of the two preceding papers—ELSON T. KILLAM, New York, N. Y.
- 10:10 **Planning the Budget for Municipally-owned Water Works**  
J. P. SCHWADA, Milwaukee, Wis.
- 10:30 **Planning Water Works Property Development**  
C. J. ALFKE, Weehawken, N. J.  
Discussion—ROGER W. ESTY, Danvers, Mass.
- 11:00 **Administrative Problems of Joint Collection of Water and Sewage Charges**  
FRANK O. WALLENE, *Chairman*, Cleveland, Ohio.

#### PURIFICATION DIVISION

##### *Symposium on Water Quality*

- 9:30 **General Statement**  
GEO. D. NORCOM, New York, N. Y.
- 9:45 **Standards of Raw and Treated Water Quality**  
H. W. STREETER, Cincinnati, Ohio.
- 10:15 **Waterborne Gastro-Enteritis**  
C. R. COX, Albany, N. Y.
- 10:45 **Bacteria from Chlorinated Waters**  
PROF. MAX LEVINE, J. M. COBLENTZ and PHILIP CARPENTER, Ames, Iowa.
- 11:15 **Factors Affecting the Efficiency of Chlorination**  
DR. F. C. SCHMELKES, ELIZABETH S. HORNING and  
GEO. A. CAMPBELL, Belleville, N. J.
- 11:45 **General Discussion—Open to All**

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## THURSDAY MORNING

### GENERAL SESSION ON PURIFICATION

- 9:30 Further Notes on Cast Iron Pipe Corrosion and its Control  
THOS. H. WIGGIN, New York, N. Y.
- 9:50 The Correlation Between the Carbon Dioxide and Mineral  
Content of Water and its Corrosivity  
WILLEM RUDOLFS and  
T. T. WONG, New Brunswick, N. J.
- 10:15 The Threshold Treatment of Municipal Water Supplies  
OWEN RICE and  
G. B. HATCH, Pittsburgh, Pa.
- 10:35 Open Discussion
- 10:50 Super-Chlorination Practice in North America  
HARRY A. FABER, New York, N. Y.
- 11:20 Recent Experiences with Carbonaceous Zeolites  
S. B. APPLEBAUM, New York, N. Y.

### FINANCE AND ACCOUNTING DIVISION

- 9:30 Recent Decisions and Rulings Concerning Water Works  
JOHN H. MURDOCH, JR., New York, N. Y.
- 10:15 Water Bills as a Lien against Property  
H. L. MEITES, Chicago, Ill.
- 10:45 Maintaining Public Confidence  
THAD. M. ERWIN, Los Angeles, Calif. and  
M. F. HOFFMAN, Cincinnati, Ohio.
- 11:20 Increasing the Efficiency of Water Systems  
A. T. COOK, Lawrence, Kan.  
Discussion—W. R. LADUE, Akron, Ohio.

## THURSDAY AFTERNOON

### PLANT MANAGEMENT AND OPERATION DIVISION

- 2:00 Developing Meter Specifications  
S. F. NEWKIRK, JR., Elizabeth, N. J.  
Discussion
- 2:45 Developing Distribution System Records  
W. V. WEIR, University City, St. Louis, Mo.  
Discussion
- 3:30 Service Line Materials—A Progress Report  
WALTER A. PEIRCE, Racine, Wis.  
Discussion led by S. H. TAYLOR, New Bedford, Mass.
- 4:00 Applicability of Various Service Line Materials  
E. SHERMAN CHASE, Boston, Mass.
- 4:30 Round Table Discussion: Application of Cathodic Protec-  
tion to Water Towers and Tanks—Led by W. W. MORE-  
HOUSE, Dayton, Ohio.

## OUR ZEOLITES—BASEX AND HI-BASEX

Perfection in highly refined, durable, ef-  
ficient greensand zeolites for open grav-  
ity or closed pressure water softeners.

*Extensively used with entire satisfaction for over 15 years*

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**HUNGERFORD & TERRY, Inc., Clayton, New Jersey**  
also manufacturers of the well known INVERSAND water softener

See the

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**UNIVERSAL CAST IRON PIPE**

**EXHIBIT at the A.W.W.A.**

**Convention—Atlantic City—June 11-15**

**THE CENTRAL FOUNDRY COMPANY**

**386 FOURTH AVE. NEW YORK, N. Y.**



(Continued from page 22)

DANA E. KEPNER, Mfg. Rep., 1921 Blake St., Denver, Colo.  
 ALAN D. DRAKE, 207 Lancaster Ave., Buffalo, N. Y.  
 TOM M. STARNES, P. O. Box 2603, Birmingham, Ala.  
 A. D. SHAW, Cons. Engr., 1300 Statler Bldg., Boston, Mass.  
 M. B. CUNNINGHAM, Engr. & Supt., Water Dept., Oklahoma City, Okla.  
 A. G. MOFFAT, Secy., Sewerage & Water Board, 526 Carondelet St., New Orleans, La.  
 O. D. DEHART, Pittsburgh Des Moines Steel Co., Praetorian Bldg., Dallas, Texas.  
 ASHLEY G. CLASSEN, Supt., City Water Works, El Paso, Texas.  
 JACK C. LINDSEY, Asst. Supt., Water Dept., Seattle, Wash.  
 BEN S. MORROW, Engr., Water Bureau, 209 City Hall, Portland, Oregon.

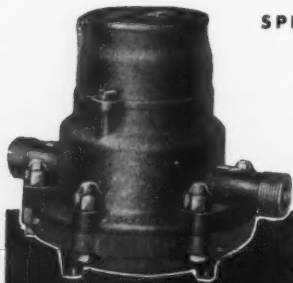
**Chicago, Ill. Committee**

LORAN D. GAYTON, City Engineer, 402 City Hall, Deputy Chairman.  
 LEWIS I. BIRDSALL, General Chemical Company, 105 West Madison Street.  
 C. R. KNOWLES, Superintendent, Water Service, Ill. Central System.  
 THOS. F. WOLFE, Research Engineer, 122 South Michigan Avenue.  
 WILLIAM T. BIRCH, Birch Pump Valve Company, 1521 Sedgwick Street.

**St. Louis, Mo. Committee**

W. V. WEIR, Superintendent & Engineer, St. Louis County Water Company, 6600 Delmar Block, University City, Deputy Chairman.  
 JOHN B. DEAN, Water Commissioner, 312 City Hall.  
 TOM J. SKINKER, 6251 San Bonita Avenue.  
 JOHN C. PRITCHARD, Cons. Engineer, 4903 Delmar Blvd.  
 R. E. WACHTER, Asst. Engr. Missouri Pacific Ry., Missouri Pacific Bldg.

**FIRST QUALITY METERS EXCLUSIVELY**



SPECIFY

*American or Niagara*  
 (BRONZE CASE) (IRON CASE)

*Water Meters*

WRITE FOR CATALOG

**BUFFALO METER COMPANY**

Established 1892

2914 Main St., Buffalo, N. Y.

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 Meter  
 service  
 from 3/8  
 made in  
 type, wit  
 able bot

From the time the metal is poured, to the finished meter, every step in Trident Meter production is under expert scientific supervision. Circular illustration shows Trident Disc Cham-

bers . . . these can be furnished in metal mixtures suited to local corrosive waters or other factors.



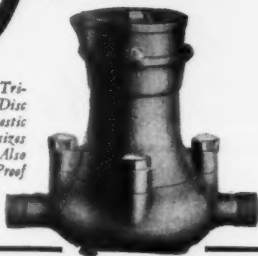
*Supremacy*

*Trident*

—in Quality  
—in Service

Trident Water Meters are products of precision manufacturing methods. They have established a world-wide reputation for simplicity, sustained accuracy and low maintenance cost over many years of use. Interchangeable parts protect against obsolescence, depreciation. Neptune Engineering Service is at the command of users, to solve all water meter problems . . . as, for instance, that of overcoming specific corrosive conditions with special mixtures of metals. There is a Trident Water Meter for every need. During the past 47 years over 7 million Neptune-built Meters have been made and sold, the majority of which are still in use. Write for Catalog.

● The famous Trident Split Case Disc Meter. For domestic service. Made in sizes from  $\frac{3}{8}$ " to 1". Also made in Frost Proof type, with breakable bottom.



## NEPTUNE METER COMPANY

50 West 50th Street  
(Rockefeller Center) New York City

Branch Offices in Principal Cities.

Neptune Meters, Ltd., 345 Spadina Avenue,  
Toronto, Canada.

### Correction to Gate Valve Specifications

If reference is made to the gate valve specifications which appeared in the March, 1939 Journal of the American Water Works Association or in reprints thereof which have since appeared separately, Section 16.4 will be found to read as follows:

In double disc gate valves of other design, the discs shall be carried on solid bronze rollers securely attached to them, except that in valves 16 inches in diameter bronze shoes may be used instead of rollers.

This paragraph should be corrected to read as follows:

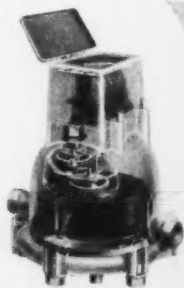
In double disc gate valves of other design, the discs shall be carried on solid bronze rollers securely attached to them except that in valves 16 inches *and larger* in diameter, bronze shoes may be used instead of rollers."

### Why does the EMPIRE METER cost less in the long run?

The sensible way to figure the actual cost of a water meter is the first cost, plus all repair and replacement costs, divided by years of service.

And even this method does not tell the whole story, for a less accurate meter than the Empire can cause undetected losses in water revenue far in excess of the first cost of the meter.

The Empire Meter is no cheaper in first cost than other meters... but maintenance records of municipalities and water companies alike prove that this meter requires less repair and fewer replacements than any other meter manufactured.



Add to this recognized fact that the Empire Meter is also the most accurate meter manufactured, and the answer is maximum water revenue at the lowest over-all cost.

**Remember this...** maximum accuracy on large and small flows + fewer stoppages and stickages + minimum maintenance = maximum water revenue.

### NATIONAL

National Meter Company, 4207 First Ave., Brooklyn, N. Y.  
BOSTON CHICAGO DALLAS LOS ANGELES SAN FRANCISCO

*Meters*

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## NEWS OF THE FIELD

**Frederick H. Weed** has resigned as Division Engineer of the Flood Control Bureau, Water & Power Resources Board of Pennsylvania, to become affiliated with the Federal Power Commission, Washington, D. C. Mr. Weed's new assignment is on the flood control reservoirs above Pittsburgh, which covers the same field as his previous work.

**James C. Vaughn** has been appointed Superintendent of the Filtration Plant and High Lift Pumping Station at Hammond, Indiana. Mr. Vaughn retains his former duties as Chief Chemist for the Department of Water Works of that city.

**John W. Krause** is now Chief Engineer of the La Grange, Illinois, Water Works. He was formerly Superintendent of Public Works at Brookfield, Ill. The La Grange Water Works was recently acquired by the city from the Public Service Company of Northern Illinois. La Grange is constructing a 3-million-gallon lime and zeolite softening plant.

**Industrial Chemical Sales Division**, West Virginia Pulp and Paper Company, Chicago, moved its offices on April 15 from 205 West Wacker

*(Continued on page 38)*



## STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains—under paved streets, railroads or over bridges—you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

### HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church Street, New York, N. Y.  
General Offices and Works: West Medford Station, Boston, Mass.

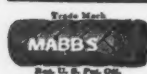


A Symbol  
of  
Quality

# HYDRO-TITE

Reg. U. S. Pat. Off.

A DEPENDABLE SELF-CAULKING JOINT COMPOUND



PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

## MABBS RAWHIDE PACKING

on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

Why not use it in your plant and benefit thereby?

MABBS HYDRAULIC PACKING COMPANY, Inc. 1892, 431 S. Dearborn St., Chicago, Ill.

(Continued from page 37)

Drive to 35 East Wacker Driver, Chicago. The move was made to obtain larger and better office facilities.

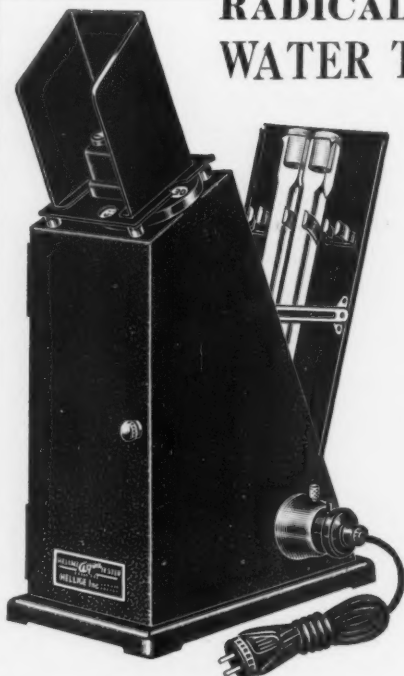
Douglas Dow, formerly Vice-President of the Detroit Board of Water Commissioners, became President of the Board on March 1, 1939. He is the son of Alexander Dow, former Board member.

H. L. Williams, Superintendent of the Ludington, Michigan, Water Department, retired on January 1, 1939. He has been a member of the Association since 1894.

"Stop diverting water works revenue" was the strongly worded recommendation given to the city council in Moline, Illinois, by the water works advisory committee which serves the city without compensation. The

(Continued on page 40)

## RADICALLY IMPROVED WATER TEST COMPARATOR



The new Hellige Aqua Tester combines the thoroughly demonstrated advantages of Hellige *non-fading glass color standards* with radical improvements in design. This new model is, we believe, the most advanced type ever brought on the market and demands special consideration as it brings to its user the utmost in permanent reliability, accuracy, convenience and, last but not least, economy. Standards for all popular A. P. H. A. and A. W. W. A. Methods and Hydrogen Ion Control are available.

Write for Bulletin No. A-611.

## HELLIGE

INCORPORATED

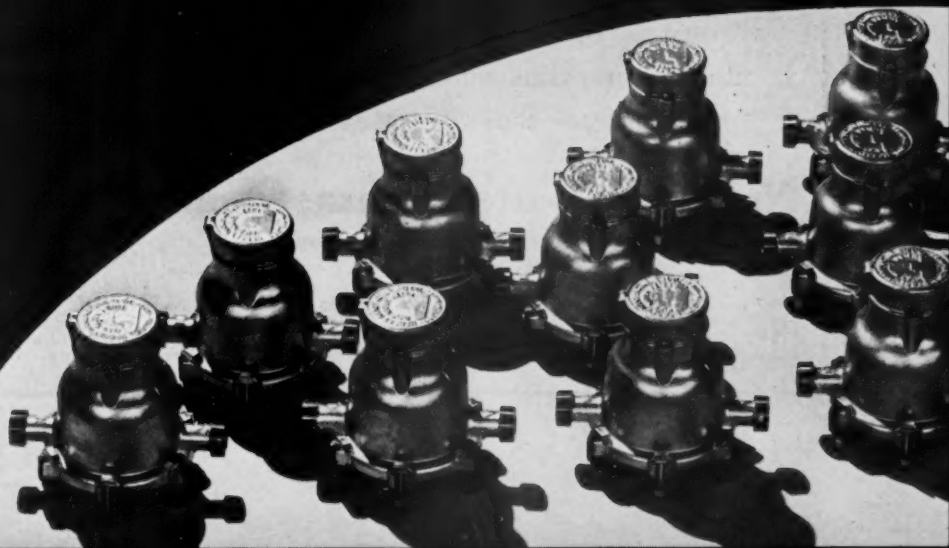
3710 NORTHERN BLVD. LONG ISLAND CITY, N.Y.

# HERSEY

THE name Hersey has been synonymous with good Water Meters for more than half a century. Water Works officials know that Hersey never sacrifices the highest standards of accuracy and dependability to meet cheap competition.

**HERSEY MANUFACTURING COMPANY**  
SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK PORTLAND, ORE. PHILADELPHIA  
ATLANTA—DALLAS CHICAGO SAN FRANCISCO LOS ANGELES



*(Continued from page 38)*

committee, composed of A. C. Grantz, Henry Hintz and E. Winholt, all engineers, urged that all money earned by the water works be kept in the water works fund to insure continuity of the water works operation, provide funds for improvements and extensions as required and maintain the plant in first class condition.

The committee praised the economical and efficient operation of the water works in late years and recommended that all water department personnel be placed under civil service regulations in order to insure continuance of efficient operation. The report also called attention to the fact that the National Board of Fire Underwriters recommends the civil service system for operation of water plants in order to avoid drastic changes in personnel without reasonable cause.

**When is a break** in a water line not altogether a tough break for the water department? Answer: When, as on March 10, 1939, a line broke in Alliance, Ohio, shutting off the water supply to over 20,000 inhabitants, and causing a considerable number of the consumers to draw hasty conclusions. Putting together the fact that the water was conspicuous by its

*(Continued on page 42)*

## CLEAN YOUR WATER MAINS

One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

### National Water Main Cleaning Co.

50 Church St., New York, N. Y.

#### BRANCHES

115 Peterboro St., Boston, Mass.  
910 William-Oliver Bldg., Atlanta, Ga.  
7103 Dale Ave., St. Louis, Mo.  
208 E. Forsyth St., Jacksonville, Fla.

3812 Castellar St., Omaha, Neb.  
2587 Glen Echo Drive, Columbus, Ohio  
501 Howard St., San Francisco, Calif.  
58 Pelham Ave., Toronto, Canada.

Copies of  
**Graph & Nomogram**  
from

Charles P. Hoover's  
**Practical Application of  
the Langelier Method**  
Jour. A. W. W. A., 30: 1802 (1938)

are now available at  
the A. W. W. A. office.

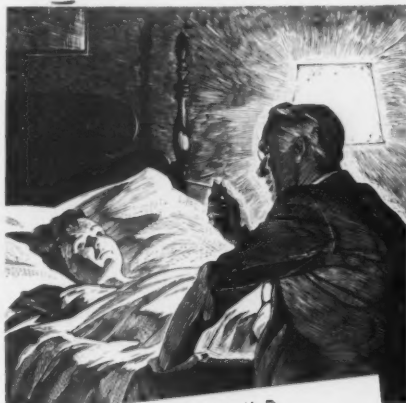
Send 10 cents in stamps  
or coins for single copies,  
to cover cost of printing  
and mailing, to:

**American Water Works  
Association**  
22 East 40th Street  
New York City

These copies are flat, un-  
bound, unaccompanied  
by text matter.



**"C'MON IN, DAN,  
THE WATER'S SWELL"**  
(BUT IT WASN'T SO CLEAN)



JOHN DOE, M. D.  
Patient's Record

Name *Harvey, Edward* age *11*  
*416 Pine St*

Examination *Temp 104. Pulse slow, blood*  
*count shows leukopenia. Mother states*  
*child has had only sterilized milk, has*  
*been swimming daily in Johnson's*  
*Creek where town sanitation Committee*  
*recently discovered typhoid bacilli.*

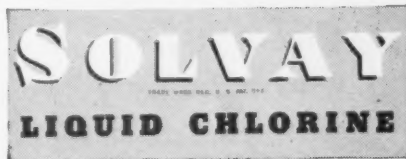
\* Reduced white blood corpuscles.

Johnson's Creek might be any  
creek or stream throughout the country—  
Edward Harvey, any American boy . . .

Pollution of streams by sewage (and some  
insufficiently purified effluent from plants) is  
fast becoming a major problem. *Be doubly  
certain!* Purify all effluent from disposal  
plants with Solvay Liquid Chlorine!

Immediate shipments of Solvay Liquid  
Chlorine are available in cylinders or tank  
cars for swimming pools, sewage and water  
purification plants.

**SOLVAY SALES CORPORATION**  
Alkalies and Chemical Products Manufactured by  
The Solvay Process Company  
40 RECTOR STREET NEW YORK, N. Y.



**COOK  
Well  
Strainers**

( A reciprocal relation, the life and functioning of the one depending much on the other. )

( **A. D. COOK, INC.**  
**Lawrenceburg - Indiana** )

**COOK  
Deep-Well  
Turbine  
Pumps**

(Continued from page 40)

absence and the fact that as non-paying consumers they had received only a few days previously some red cards, the delinquents hastened to the city hall and paid their bills.

**A Submerged-Suction Priming System** for pumps has been developed by the De Laval Steam Turbine Company, Trenton, N. J. By this system the pump is kept full of water at all times, whether running or standing, just as if the pump were located below the supply. The system also is designed to remove continuously any reasonable amount of air inleakage.

**A fellowship** for the purpose of conducting research on problems pertaining to processes of fabricating and to the use of metal tanks, pressure cylinders, and water-softening equipment has been established in Mellon Institute by Wm. B. Scaife & Sons Company. The incumbent will be

(Continued on page 43)

## Warren Foundry & Pipe Corp.

ALSO

**Warren Pipe Co. of Mass., Inc.**

*SALES OFFICES*

**11 BROADWAY, NEW YORK  
75 FEDERAL ST., BOSTON, MASS.**

*Manufacturers of*

## CAST IRON PIPE

**Sizes 2' to 84'**

***Flanged Pipe***

***Flexible Joint Pipe***

***Bell and Spigot Pipe***

***Special Castings***

***Short Body B. & S. Specials***

***Warren  Spun Centrifugally Cast Iron Pipe***

**WORKS: PHILLIPSBURG, N. J. and EVERETT, MASS.**

**Large Stock Enables Us to Make Prompt Shipments**

(Continued from page 42)

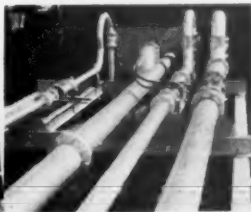
Dr. H. L. Anthony, III, who studied at Lafayette College, University of Alabama and Harvard University, and has been employed in the metallurgical department of the Carnegie Steel Company at Homestead, Pa. and the research laboratory of the Midvale Company in Philadelphia.

The American Society for Testing Materials has announced a change in its method of publishing A. S. T. M. standards. Standards and tentative standards will be published collectively in one triennial publication, divided into three parts: Part 1, Metals; Part 2, Non-Metallic Materials—Constructional; and Part 3, Non-Metallic Materials—General. Publication of new and revised tentative standards in the annual *Proceedings*, Part 1, will be discontinued; the *Proceedings* including both committee reports and papers (about 1300 pages double-column format) will be bound in one volume. The publication of the annual Book of Tentative Standards will be discontinued entirely. Each of the 870 A. S. T. M. standards continues to be available in separate pamphlet form. Further details of the publication plan can be obtained from the headquarters of the Society at Philadelphia, Pa.

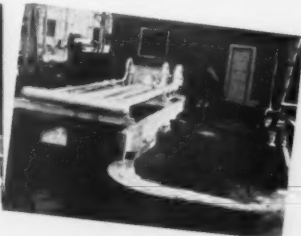
(Continued on page 44)



Venturi Manometer  
accurately indicates flow



3", 5", and 8"  
Venturi Tubes in test lines



Flow discharges into weir channel

## Venturi Meters used in rating Layne Pumps

Today many leading pump manufacturers use Venturi Meters for pump rating tests. (Photos show test layout made for Layne & Bowler, Inc., by their Chief Engineer, A. B. Fabrin.) For a modest investment the pump manufacturer gains in two ways: (1) he saves time as compared with use of weir measurements; and (2) in using Venturi Meters he is rating his pumps against the same standard of flow

accuracy which will be used in the field "acceptance tests".

Whether you want to meter flow, with Register located adjacent to the Tube; or whether the reading must be transmitted miles away to show flow rates to distant supervisors, or to automatically control operation of pumps, Venturi accuracy is important.

*Write for bulletins*

**BUILDERS IRON FOUNDRY, 9 Coddling Street, PROVIDENCE, R. I.**

(Continued from page 43)

**Control of cross-connections** was established by the city of Sandusky by ordinance on November 21, 1938. This is an example of an apparent trend toward control of cross-connections locally with only general supervision and coöperation by a state board of health. A section of the same ordinance recommends a standard color system for designating pipes within industrial plants. Important sections of the ordinance follow:

"Section 1. That it shall be unlawful for any official, officer, or employee having in charge or being employed in the maintenance and operation of the water works system in the City of Sandusky, Ohio, or for any other person, firm or corporation to establish or permit to be established any connection whereby a private, auxiliary or emergency water supply other than the regular public water supply of the City of Sandusky may enter the supply or distributing system, unless such private, auxiliary or emergency water supply, and the method of connection and use of such supply shall have been approved by the State Department of Health and the City of Sandusky, Ohio.

"Section 2. That all buildings within the City of Sandusky, Ohio, using city water, except buildings used for dwelling purposes only, shall have a complete map of city water piping layout; which said map shall be filed with the City Manager of the City of Sandusky, Ohio. That any change in the city water piping layout, in said buildings other than buildings used for private dwelling purposes only, before same is made, shall be submitted to the City Manager and to the City Engineer of the City of Sandusky, Ohio, for their approval, and said change shall not be made until approved by said officials.

"Section 3. It is recommended that all city water piping layouts, in buildings other than those used for private residential purposes, within the City of Sandusky, Ohio, shall be painted a standard color, as hereinafter designated, to-wit:

Fire system—Red.

Raw water—Orange.

City water for processing—Hiway yellow.

City water for human consumption—Green.

"Section 4. That all persons, firms or corporations within the City of Sandusky, Ohio, having cross-connections between public and private water supplies shall remove same within fifteen (15) days after notice from the City Manager or City Engineer of the City of Sandusky, Ohio."

## NEWS OF THE FIELD



J. Arthur Jensen



Norman J. Howard

**J. Arthur Jensen**, President of the A. W. W. A., 1939-1940, and Chief Engineer, Water Department, Minneapolis, Minn., was born on a farm at Brooklyn Center, Minnesota, where he lived until he was 15. He taught rural school for a short period, then finished high school at Fergus Falls, Minn., in 1901. In 1905 he graduated from the University of Minnesota in Civil Engineering, having worked during college vacations for the Northwestern Bell Telephone Co. Mr. Jensen was engaged in railroad construction in 1906 and 1907 with the Chicago, Milwaukee and St. Paul Railroad Company. In 1907 he joined the Minneapolis Water Department as Assistant Engineer, becoming Superintendent and Engineer in 1914.

Mr. Jensen became a member of the A. W. W. A. in 1910. Since that time he has attended 21 of the Annual Conventions, not missing one in the last 17 years. He has served as a Trustee on the former Board as well as on the Board of Directors, 1931-33. Mr. Jensen has also served on the Committee of Distribution Standards, Hydrant and Valve Specifications, Cross-Connections and Distribution System Safety. He is now Chairman of the Minnesota Section.

Mr. Jensen is at present in charge of the construction of the new softening plant at Milwaukee which will have a capacity of 120 million

*(Continued on page 2)*

(Continued from page 1)

gallons daily. Since he has been connected with the Minneapolis Water Department, two filtration plants with a total capacity of 158 m.g.d. have been built.

**Norman J. Howard**, Vice-President, was born in Ireland, and was educated in England at Xaverian College, Mayfield. He started to study medicine, but in 1907 became connected with the laboratories of Sir William Crookes and Sir James Dewar, internationally known scientists, who were then Consulting Chemists to the London water companies. Following the purchase of these companies and the formation of the London Metropolitan Water Board in 1909, Mr. Howard entered the service of the Board under the late Sir Alexander Houston.

In 1911, the City of Toronto invited him to become Assistant Chemist and Bacteriologist, at a time when the slow sand filter plant, designed by the late Allen Hazen, was being completed. He was placed in charge of laboratories in 1912, and made Director in 1927.

Mr. Howard joined the American Water Works Association in 1920 and was A. W. W. A. director for the Canadian Section from 1935 to 1937. He has taken an active part in the work of the Association. He was chairman of the A. W. W. A. Water Purification Division in 1927 and is at present chairman of the important research committee on High Rate Treatment. He is the immediate past-President of the Canadian Institute on Sewage and Sanitation and Chairman of the Public Health Engineering Division, of the Canadian Public Health Association. In addition to the organizations previously mentioned he is a member of the American Chemical Society, a Fellow of the Canadian Institute of Chemistry, Associate of Arts, University of Oxford. He has pioneered in the treatment and prevention of taste and odors in water supply. He is best known among water purification men for his development and effective control of the super-chlorination and de-chlorination of the Toronto supply. He has made many contributions to the literature of water treatment.

### Water Pollution Control Activities

The added duties assigned to the Sanitary Engineering organization of the United States Public Health Service with headquarters at Cincinnati, Ohio, have necessitated a considerable augmentation of the personnel engaged in stream pollution control activities.

The Stream Pollution Investigations Station at Cincinnati was established in 1913 by the Public Health Service, under the direction of the late Dr. Wade H. Frost, for the purpose of conducting basic research studies of the phenomena of stream pollution and natural purification of

(Continued on page 4)

# A PIPE WITH THREE LIVES...

**1901** The story begins with the installation of a 48-inch cast iron water main under North Broad Street, Philadelphia, in 1901. After 24 years of service, the construction of the Broad Street Subway required its removal. The pipe was salvaged, reconditioned and placed on sale for service not requiring A. W. W. A. wall thickness.

**1925** It is shipped by boat from Philadelphia to Los Angeles, 4866 nautical miles away, bought for the City of Glendale, California, to be used for an intercepting sewer river crossing under the Los Angeles River. It was unloaded at Los Angeles for delivery to the job at Glendale, where it was laid for the *second time*. Sold at a saving over the cost of new pipe yet having realized a good salvage value for Philadelphia, both cities benefited.

**1938** Thirteen years later a Flood Control program required deepening the Los Angeles River channel, involving relocation of the Glendale intercepting sewer. It was found economical to uncover this 48-inch cast iron line and remove it for reinstallation. Last year this pipe started out on its *third life*, after 24 years of service at Philadelphia and 13 years of service in its first location at Glendale. Barring unforeseen circumstances, this cast iron pipe line will serve for a century or more in its present location.

THIS STORY of the adventures of a 48-inch pipe line is a striking example of the salvage value of cast iron pipe. The recognized standard material for underground mains, cast iron pipe is also unequalled for long life and low maintenance cost, justifying its reputation as Public Tax Saver No. 1.



Look for the "Q-Check" registered trade mark.  
Cast iron pipe is made in diameters from 1¼ to 84 inches.

The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago

# CAST IRON PIPE

## PUBLIC TAX SAVER NO. 1

*(Continued from page 2)*

polluted water, embracing as complementary subjects, drinking water purification and the disposal of sewage and industrial wastes. This fundamental research has been continued without interruption except for the interval of the World War and, since 1922, has been under the direction of Senior Sanitary Engineer J. K. Hoskins with a well trained staff of specialists consisting of sanitary engineers, chemists, biologists, and bacteriologists.

With the increase in requests for advisory and cooperative assistance from the states, it became necessary to conserve the efforts of the research personnel. Such advisory activities were, therefore, in 1932 assigned to the Engineering Section of the Domestic Quarantine Division of the Service. To handle this cooperative function there was established a separate, new office of Stream Sanitation at Cincinnati under the direction of Senior Sanitary Engineer H. R. Crohurst.

Both of these administrative sections are cooperating in the survey of the pollution of the Ohio River authorized by the Rivers and Harbors Act of 1937 to be undertaken by the U. S. Army Engineer Corps. Upon Presidential recommendation, this survey is being supervised by a committee of three engineers, consisting of Brigadier General Max C. Tyler of the Corps of Engineers, U. S. Army, Senior Sanitary Engineer R. E. Tarbett, U. S. Public Health Service, and Dr. Abel Wolman.

The Stream Pollution Investigations Station is conducting chemical, bacteriological, and biological studies of the waters of the Ohio River proper and its principal tributaries, and is undertaking an epidemiological study of the occurrence of widespread intestinal infections to determine their possible relation to drinking water supplies obtained from seriously polluted raw water sources or which may have become contaminated before or after treatment. The Stream Sanitation office, in cooperation with state health departments, is collecting essential information on the nature and extent of sources of water pollution on the watershed, while the Army Engineer Corps is assembling detailed data on the hydrometric features, including stream flows and times of flow between sampling stations.

That part of the Ohio River Pollution Survey assigned to the Stream Pollution Investigations Station is under the supervision of Senior Sanitary Engineer H. W. Streeter. Additional scientific personnel engaged for this activity include:

Surgeon **FILIP C. FORSBECK**, formerly Epidemiologist, Michigan State Department of Health.

Associate Public Health Engineers:

**FRANK E. DEMARTINI**, formerly Water Purification Engineer, Water Department, San Francisco, California.

*(Continued on page 6)*



... and keep on saving with this rugged, light-weight pipe

**I**NSTALL "Century" Asbestos-Cement Pressure Pipe, and you save on every count. So light in weight, you need no machinery for handling, except with the largest sizes. In hauling you'll find that you can get up to twice as many linear feet in a truckload as with heavier kinds of pipe. Laying time is reduced, not only because of this lighter weight of the "Century" Pipe, but by the ease of jointing made possible by "Century" Flexible Couplings.

A remarkable new manufacturing process employed by Keasbey & Mattison builds into "Century" Pipe an exceptional degree of strength and uniformity.

This means that the inherent long life of Asbestos and Cement are here brought out to the utmost, with the result that pipe replacements are minimized. Each length must pass a series of searching tests before it is released for shipment.

"Century" Asbestos-Cement Pipe is permanently immune to corrosion, tuberculation, and electrolysis. You get a virtually maintenance-free line, and pumping cost stays low. Add up all these savings, and you have *real economy*.

See "Century" Pressure Pipe at the 59th Annual A.W.W.A. Convention at the Atlantic City Auditorium and Convention Hall, from June 11 to June 15.

## "Century" Asbestos-Cement Pipe

**KEASBEY & MATTISON COMPANY**  
AMBLER, PENNA.  
District Sales Offices in Principal Cities

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Send me, without obligation, free catalogue on "Century" Asbestos-Cement Pressure Pipe—"Mains without Maintenance."

NAME \_\_\_\_\_

NAME OF PLANT \_\_\_\_\_

ADDRESS \_\_\_\_\_ JAWA-6



(Continued from page 4)

CHARLES T. CARNAHAN, transferred from Public Health Service activities at Miami, Florida.

Assistant Public Health Engineer:

STANLEY G. MONROE, formerly Assistant Engineer, Division of Sewage Treatment, Akron, Ohio.

Bacteriologist:

BENJAMIN S. LEVINE, transferred from the National Institute of Health, Washington, D. C.

Associate Biologist:

FLOYD J. BRINLEY, formerly Associate Professor of Zoology, North Dakota State College, Fargo, N. D.

Assistant Sanitary Chemist:

WILLIAM W. WALKER, formerly Chief Chemist, Cedar Rapids, Iowa, municipal sewage treatment plant.

Junior Sanitary Chemist:

MORRIS B. ETINGER, formerly Chief Chemist, Elgin Softener Corporation, Elgin, Illinois.

Junior Sanitary Bacteriologist:

CECIL W. CHAMBERS, formerly Instructor in Bacteriology, Youngstown College, Youngstown, Ohio.

The part of the survey assigned to the Stream Sanitation Office is under the direction of Senior Sanitary Engineer H. R. Crohurst with headquarters in the Enquirer Building, Cincinnati, Ohio. Engineering personnel engaged for this part of the work include:

Sanitary Engineer (R) E. S. TISDALE, formerly State Sanitary Engineer, West Virginia Department of Public Health.

Public Health Engineer:

MAURICE LEBOSQUET, JR., transferred from U. S. Public Health Service District Office No. 3, Chicago, Illinois.

Assistant Public Health Engineers:

ARCHIE B. FREEMAN, formerly Assistant Sanitary Engineer, North Carolina State Board of Health.

MARK D. HOLLIS, formerly State Sanitary Engineer, North Dakota State Dept. of Health, Bismarck, N. D.

CHARLES R. KEATLEY, formerly Supervisor of Operation, Water Softening Plant, Greenwich Water Co., Greenwich, Conn.

GORDON E. MCCALLUM, formerly Sanitary Engineer, Kent County Health Department, Grand Rapids, Mich.

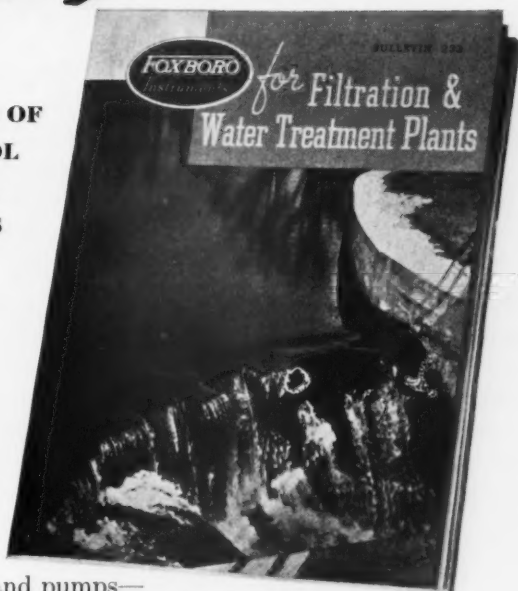
RICHARD F. POSTON, formerly Assistant Sanitary Engineer, State Board of Health, Pierre, S. D.

(Continued on page 8)

# This New Book

## FEATURES ADVANTAGES OF CENTRALIZED CONTROL OF MODERN WATER TREATMENT METHODS

This new Foxboro bulletin explains how complete and proper instrumentation of the filtration plant insures an adequate and dependable supply of pure water—at minimum operating costs. It shows how control over all valves and pumps—regardless of their location—are centralized . . . how water levels of all wells and reservoirs are known at a glance. . . . This compact, instructive bulletin will interest water-works commissioners, architects, superintendents and consulting engineers. All are invited to send for a copy. Please use your business letterhead and ask for Bulletin 223, "Foxboro Instruments for Filtration and Water Treatment Plants."



### Highlights:

- ★ Discussions of modern plant instrumentation
- ★ Suggested layouts for the control room
- ★ Application points for measurement and control
- ★ Illustrations and specifications of complete line of Foxboro instruments for water treatment methods

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REG. U. S. PAT. OFF.  
*Instruments*

**FOR WATERWORKS AND SEWAGE SYSTEMS**

(Continued from page 6)

GEORGE D. REED, formerly Water Works Engineer, Bryn Mawr, Pa.

ARVO A. SOLANDER, formerly Junior Engineer, P.W.A., New York City, N. Y.

SAMUEL R. WEIBEL, formerly with the War Department, U. S. Engineer Office, New York District, 80 Broad St., New York City, N. Y.

RICHARD L. WOODWARD, transferred from Engineering Section, U. S. Public Health Service, Washington, D. C.

CHARLES D. YAFFE, formerly Superintendent of Sewage Treatment, City of El Paso, Texas.

In addition to the Ohio River Pollution Survey outlined above, the Stream Pollution Investigations Station is engaged in various research projects pertaining to water pollution and sewage treatment.

Determination of the sanitary improvement effected in the Scioto River by treatment of the sewage of Columbus in the new activated sludge plant has been under way for approximately two years under the supervision of Past Assistant Sanitary Engineer R. W. Kehr. This work is being undertaken to evaluate, in terms of stream improvement, the treatment of sewage by the activated sludge process. Observations on the sanitary condition of a 100-mile length of the Scioto below Columbus were completed by means of a branch laboratory at Chillicothe, Ohio, for a whole year prior to the installation of the activated sludge sewage treatment plant. Observations are being continued for a similar length of time following operation of the new Columbus plant.

Research studies are in progress on the phenomena of the activated sludge sewage treatment process including the fundamental biochemical reactions involved in the oxidation of organic matter and the influence of various factors on oxidation rates. These studies are being conducted and reported by Principal Chemist C. C. Ruchhoft and Principal Bacteriologist C. T. Butterfield.

A very considerable amount of experimental data has been obtained on the rate of oxygen withdrawal from flowing water by sludge deposits on channel bottoms, under controlled conditions of temperature, depth and velocity of flow, etc. This work, under the supervision of Senior Sanitary Engineer H. W. Streeter, has been periodically reported upon as the study has progressed.

Another activity recently inaugurated under the immediate charge of Associate Sanitary Engineer Vernon G. MacKenzie, is a continuing census of water supply and sewage treatment works and water pollution abatement activities throughout the United States. It is proposed to

(Continued on page 10)

# Hydrant Breakages

## *need not cause Gutter Geysers*



A GEYSER is obviously out of place in a city street. Then why tolerate the chance of one resulting from a broken fire hydrant; with accompanying interruption to traffic, loss of water, and damage to neighboring property?

Kennedy SAFETOPS cannot flood. Their compression type inlet valve is kept tightly closed by the water pressure in the main even if they are accidentally broken.

And this is only one of the many advantages of the Kennedy SAFETOPS. Their speed and economy of repair after accidental breakage, provided by the famous Safety Breakable Section, their ease of adjustment, their prompt response and dependable operation in fire service, their simple sturdy construction and attractive appearance—all these features have made Kennedy SAFETOPS the favored hydrant in progressive communities all over the country.

Write for full information on these unique hydrants and how they can be applied economically to your existing system, as well as on new extensions.

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The Kennedy Valve Mfg. Co.  
Elmira, N. Y.

# KENNEDY



# SAFETOP FIRE HYDRANT

REG. U.S. PAT. OFF.

(Continued from page 8)

assemble specific information on the physical, structural and operating features of each individual plant and on the location and nature of water pollution problems including the progress being made in their correction. The assembled data will be available at all times for those interested and summaries will be issued periodically in published form. It is hoped to provide, by this means, statistical information on sanitary works comparable in value to the vital statistics of human populations.

To house these research projects properly and to provide adequate experimental facilities for conducting them, a new laboratory building is contemplated as soon as legal arrangements for acquirement of the site can be completed. An allotment of \$275,000 has been set aside for this purpose from funds appropriated in the general building bill of the Federal Government.

**Hiram F. Jones**, Superintendent for thirty years of the Elmira (New York) Water Board's filtration plant, died recently in St. Petersburg, Florida. He was 65 and had been ill several months.

Jones became head of the plant upon the resignation of Nelson W. Bunting, under whom he had worked for twelve years previously. He first held the position of superintendent under the Elmira Water, Light & Railroad Company. When in 1915 the municipal Utility Board was created, he continued as superintendent of the filter plant and also supervised the pumping station.

Jones was a member of the A. W. W. A. for 32 years.

**George Lebold**, for many years Superintendent of the Meter Department of the Hackensack Water Company, died of heart disease on May 11.

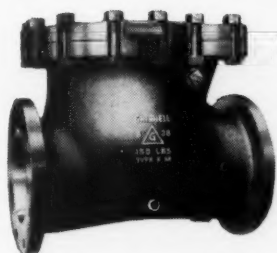
Mr. Lebold, who was 69, was born in Brooklyn, N. Y., and began his career as a machinist. By 1902 he was foreman of testing for the National Meter Company and in January, 1903, he joined the Hackensack Water Company as foreman of the Meter Department. Under his direction, the department expanded with the growing population into a modern plant through which now pass for test and servicing more meters in each year than there were on the whole system in 1903.

Lebold was a member of the A. W. W. A. for the past 14 years.

(Continued on page 12)



# CHECK VALVES for Complete Control



\*Uniflow Check Valves



‡Detector Check With  
Meter In By-Pass

\*Grinnell Uniflow Check Valves are all bronze, with bronze clappers and molded rubber facings. They are made to specifications of, and approved by, Factory Mutual Laboratories and the Underwriters' Laboratories, Inc.

Used in pairs, these check valves stop water from secondary source backing up in public mains, thus preventing contamination.

• • • • •

‡Leakage or possible misuse of water in fire protection equipment is "detected" with the Grinnell Detector Check Valve. Iron Body, bronze mounted, with moulded rubber facings. Approved by the Factory Mutual Laboratories and the Underwriters' Laboratories, Inc. By-pass and meter accurately measures flows to slightly over 25 gallons per minute, fully sufficient to indicate any flow except for fire extinguishment. Grinnell Co., Inc., Executive Offices, Providence, R. I., Branch offices in principal cities.

# GRINNELL

WHENEVER PIPING IS INVOLVED

(Continued from page 10)

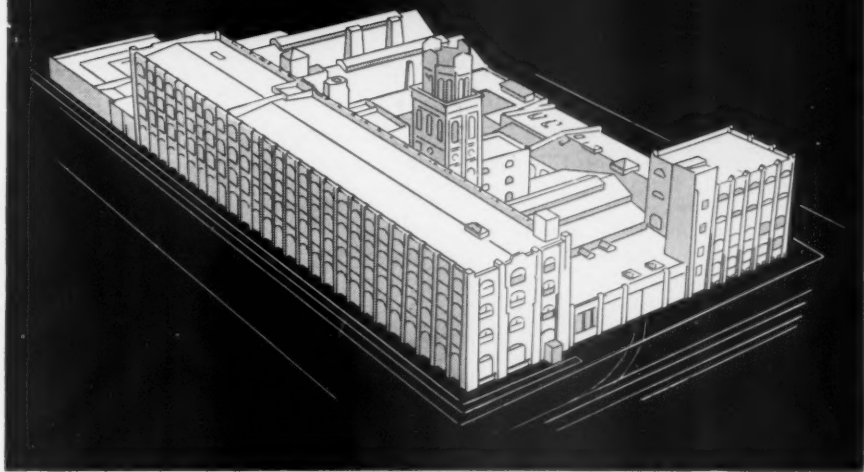
## New Materials and Gadgets

1. **For cleaning the inside of pipes** up to six inches in diameter, there has been developed a machine which uses a flexible spiral cable. Cutting tools or brushes on the front may be driven through sharp coils or traps.
2. **A small desk timer** has been designed primarily for telephone use. It may be set for 3-5 minutes. It shows the total time and rings a bell 15 seconds before the end of the period.
3. **A tiny electric boiler** is made to generate superheated steam in 15 seconds, one of its uses being for sterilizing. It is about the size of a fruit jar and operating continuously it consumes 5 pints of water an hour.
4. **A quick-acting paint remover** containing no caustic or alcohol has been developed to remove paint within ten minutes with a single application the rule. It is claimed that it will neither burn through nor harm brushes.
5. **Interior communication** is made possible by a system employing a standard electric typewriter which when not in use for communication can be used as a typewriter. Either one-way or two-way communication with two or more machines is possible.
6. **A new mineral product to replace sand** is said to make a harder and tougher concrete. It is crushed, washed, dried and graded for size.
7. **A new air-cleaner** combines an automatic self-cleaning viscous air filter with electrical precipitation and is said to give unusual efficiency in cleaning.
8. **A crayon** has been developed which will write on hot metals without melting and running off. When used on cold metals, the mark is not obliterated by heating.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items and citing the June issue as the source.

(Continued on page 14)

**"to sell meters on**  
*Performance"*



Established in 1870, the National Meter Company is, today, one of the oldest organizations engaged in the manufacture of water meters. • Throughout these sixty-nine years, this company has led in developments which have advanced metering from an experiment to an economic essential . . . developments which have advanced the manufacture of meters from an idea to an industry • At no time has this company introduced inconsequential "innovations" simply for the sake of offering "something different . . . something new." At no time has this company swerved from its sound and conservative sales and advertising policy of selling National Meters on performance . . . not on glowing promises and exaggerated claims. • Whether you are interested in accuracy on small flows or large . . . in lower repair and replacement costs . . . in obviating obsolescence . . . get the facts on National Meters first

**NATIONAL** *Meters*

NATIONAL METER COMPANY • 4207 First Avenue • Brooklyn, N. Y.  
 BOSTON • CHICAGO • DALLAS • LOS ANGELES • SAN FRANCISCO

*(Continued from page 12)*

Louis A. Geupel has been made Superintendent of the Evansville, Indiana, water department. He has been City Civil Engineer in Evansville since 1936 and has been Acting Superintendent during the illness of the late Charles Streithof. Mr. Geupel continues as a member of the Indiana Board of Engineering Registration.

The "Proportioneers" Trailer will travel through the water works plants of North America this season with H. N. Armbrust at the wheel. Jeff Corydon handled it for eleven months and 20,000 miles last season without a single pinch ticket.

The Annual Meeting of the American Society for Testing Materials will be held this year at Chalfonte-Haddon Hall, Atlantic City, N. J., June 26 to June 30. Upwards of twenty separate technical sessions will be necessary at this meeting to provide for the presentation of the large number of technical papers and reports. Quite a number of the sessions will be held as round-table discussions and others will feature symposiums comprising several papers on a particular subject. Throughout the week

*(Continued on page 16)*

## EDSON DIAPHRAGM PUMPS

Hand Operated—size 2", 2½", 3", 4"

Power Operated—size 3" and 4"

Open Discharge or Force Pump  
Skid, Truck or Trailer Mounted

Complete Pump Outfits, Genuine  
Edson Pumps, Suction Hose,  
Brass Couplings, Bronze Clamps,  
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Silica Mines  
THOMASVILLE, GEORGIA

# ALCO

## ELECTRIC WELDED *Steel pipe*



84" Alco Electric Welded Steel Pipe landing into the new Fridley Softening Plant of the City of Minneapolis. J. A. Jansen is Chief Engineer of Water Works. The pipe is 17/32" thick, hot dip-coated, with riveted field joints every forty feet.

### *Alco Features*

GREATER STRENGTH

LONGER LIFE

SMOOTHER WATERWAY

LONGER LENGTHS

FEWER FIELD JOINTS

LOW INITIAL COST

ULTIMATE ECONOMY

• Since 1897 Minneapolis has been using steel pipe and now has more than 200,000 feet of it over 30" in diameter in water works and sewage service. All this pipe is in excellent condition. The maintenance cost during 41 years of service has been practically nil—no breaks, no shutdowns for repairs.

Why not be guided by the experience of this progressive city?

# ALCO PRODUCTS

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AMERICAN LOCOMOTIVE COMPANY

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NEW YORK, N. Y.

AMERICAN LOCOMOTIVE SALES CORP.

ARTILLERY HOUSE, ARTILLERY ROW, LONDON, S. W. 1, ENGLAND

*(Continued from page 14)*

of the meeting, there will be in progress the Fifth Exhibit of Testing Apparatus and Related Equipment, and also the Society's photographic display, which this year will be devoted to the theme "Testing and Research in Engineering Materials."

Among the important technical features are discussions on paint testing, shear testing of soils, quantitative spectrochemical analysis, effect of subatmospheric temperatures on the properties of metals, and freezing and thawing. There will also be groups of papers covering water, fatigue of metals, asphalt, radiography, and concrete and concrete aggregates. Of six papers already scheduled on water, one covers pH dissolved ion concentration and solid products resulting from the reaction between iron and pure water at room temperature; another is on the calculation of the distribution of carbon dioxide between water and steam; a third deals with the calculation of equilibria in dilute water solutions with applications to industrial water treatment; and other papers are on industrial uses of water and steam.

At Toronto, Ontario, an interesting program involving both water supply and sewage treatment is taking form. The water supply, taken

*(Continued on page 18)*

## Warren Foundry & Pipe Corp.

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## CAST IRON PIPE

Sizes 2' to 84'

***Flanged Pipe******Flexible Joint Pipe******Bell and Spigot Pipe******Special Castings******Short Body B. & S. Specials******Warren (WF) Spun Centrifugally Cast Iron Pipe*****WORKS: PHILLIPSBURG, N. J. and EVERETT, MASS.****Large Stock Enables Us to Make Prompt Shipments**

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OUTBREAKS  
in the  
UNITED STATES  
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CANADA

1920-1936

by  
Arthur E. Gorman  
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An unparalleled summary of studies concerning the relation of water supplies to typhoid fever, gastro-enteritis, etc.

A brochure that should be in the library of every sanitary engineer.

Price \$1.25—postpaid if cash or check accompanies the order.

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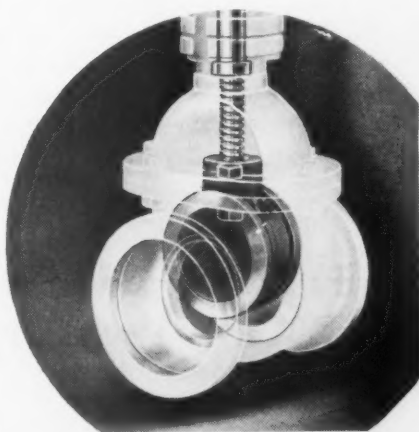
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*Valve*  
PROVIDES  
*Positive Closure*

A valve must provide positive closure, even after years of service in the open position. The best valve guarantees this effect with wide, self-releasing 30° angle wedges, and *flexible-action* gates which automatically adjust themselves to seats.

The best valve also assures smooth, positive operation by unwedging and freeing gates *before* raising, wedging them only when they are directly opposite ports. It cleans itself and has no internal guides to cause foul-up; it allows ready replacement of parts through ample tolerances.

Only the parallel seat, double wedge type slide gate valve provides all these essential benefits. This principle, developed and perfected by Ludlow, has been the universally accepted construction in all *water works valves* for nearly three-quarters of a century.

Information free on request.

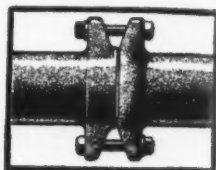


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**LUDLOW**  
SINCE 1866  
**VALVE MFG. CO.**  
TROY, N. Y.

# UNIVERSAL CAST IRON PIPE LAID WITH JUST WRENCHES



No other tools are needed. No lead, no pouring, no bell holes to dig. Machined iron-to-iron flexible joints. **SPEEDIEST...EASIEST...SAFEST.** Highest quality Cast Iron.



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OFFICES IN PRINCIPAL CITIES COAST TO COAST

(Continued from page 16)

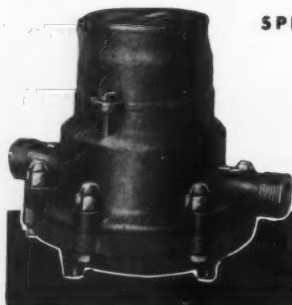
from Lake Ontario, has been affected adversely for some years by the inadequate method of sewage disposal. A report on a sewage treatment plant has been before the council for some time. A further step has now been taken in which a Board of Engineers has been appointed to review the situation and to report on the degree of treatment which will be necessary. Both the water supply and bathing beaches are involved. The Board consists of the following:

S. A. Greeley, Consulting Engineer, Chicago; C. W. Hubbell, Consulting Engineer, Detroit; W. B. Redfern, Consulting Engineer, Toronto; A. E. Berry, Provincial Sanitary Engineer, Toronto; and G. H. Ferguson, Chief Engineer, Federal Department of Pensions and National Health, Ottawa, Ontario.

Versailles, Indiana, has been given a new \$200,000 water works and sewage system. James H. Tyson, former member of the Board of the Walgreen Drug Co. and a former resident of Versailles, is the donor. Mr. Tyson has given the town almost a million dollars over a period of years, a part of which was a quarter-million dollar church.

(Continued on page 20)

## FIRST QUALITY METERS EXCLUSIVELY



SPECIFY

*American or Niagara*  
(BRONZE CASE) (IRON CASE)

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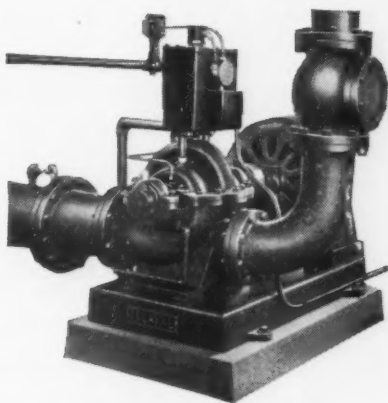
**BUFFALO METER COMPANY**

Established 1892

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# DE LAVAL Submerged-Suction PRIMING EQUIPMENT

Converts a centrifugal pump into a non-stallable pumping unit



**T**HE DE LAVAL system automatically holds the liquid above the eye of the impeller, keeping the pump, the suction line, and all connections continuously full, so that the pump will deliver whenever its motor is running.

There is no check or foot valve in the pump suction line and the pump can be drained completely at any time and opened for upkeep and maintenance. The expense and many difficulties of deep pump pits are avoided.

No manual attention is required and there are no floats or pressure switches in the priming system. Ordinarily, once the pump is in operation, no further power is taken for priming.

Where De Laval pumps so equipped that they can be operated dry are driven by synchronous motors with a limited "pull-in" torque, the De Laval submerged-suction priming system can be put into operation by a suitable relay after the driving motor is locked in synchronism.

*Full particulars are given in Leaflet SP-1, sent upon request.*

844

## DE LAVAL

*Steam Turbine Co.*  
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MANUFACTURERS OF STEAM TURBINES, PUMPS—CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, CENTRIFUGAL BLOWERS AND COMPRESSORS, WORM GEARS, HELICAL GEARS, HYDRAULIC TURBINES, AND FLEXIBLE COUPLINGS—SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM

(Continued from page 18)

Tyson's contribution was supplemented by P.W.A. which donated 45 per cent of the funds for the water works. Versailles has drawn its supply in the past from wells which could not be relied upon, there being an acute shortage each summer. For several years, all the water used in the schools has been hauled by truck from a town five miles away. Now the town has modern water and sewerage facilities as a result of the generosity of one of its former residents.

**A bill permitting liens against property** for water bills has been at least temporarily defeated in the State Legislature of Michigan. By a vote of five to four the Utilities and Transportation Committee of the State Senate postponed discussion indefinitely and this amounts to a virtual killing of the bill.

Many Michigan cities, including Detroit, have for decades followed the practice of putting liens on property to satisfy water bills. On petition of the Home Owners Loan Corp., the ruling was made in court that the lien system, which is in the City Charter of Detroit, was invalid because of the absence of a specific State enabling act. The Michigan Sec-

(Continued on page 22)

### First Shipment on Largest Order for 30" Centrifugal C. I. Pipe Ever Placed in U. S.!



**PHOTO** shows a solid trainload—36 cars—of 30" Mono-Cast Enameline Pipe leaving "Acipco" enroute to Greenville, S. C., for installation in water works improvements and new water supply line. Project requires 121,000 ft. of 30" pipe—largest such order ever placed in the U. S.—and all to be furnished by this company. "Acipco" offers unexcelled facilities and service in producing centrifugal c.i. pipe in diameters from 3" to 36" inclusive. Get the details at our booth at the AWWA meeting at Atlantic City, or write for literature.

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New York City Chicago Kansas City Minneapolis Dallas  
Los Angeles San Francisco Pittsburgh Cleveland

### Cathodic Protection for Steel Water Tanks

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**ELIMINATE**

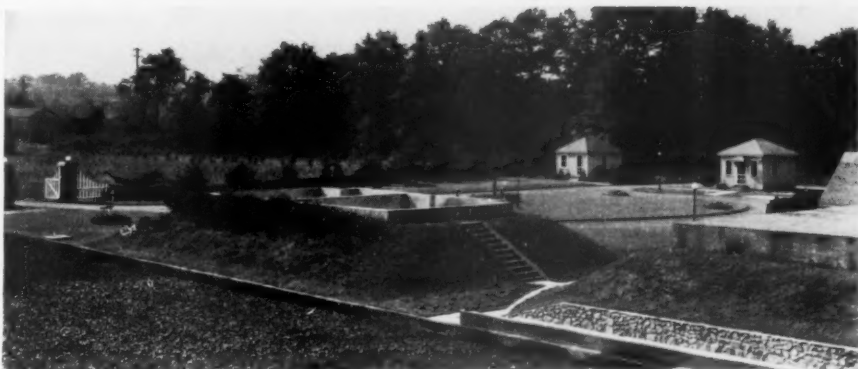
Rusting  
Corrosion  
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below the water line.

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*Guaranteed to save its cost  
at least once every four years.*

**RUSTA** TRADE MARK  
REGISTERED  
PAT. PEND. **RESTOR**

FREMONT, OHIO

# RIDGEWOOD, N. J. SEWAGE PLANT CITES SUCCESS WITH G. C. 'ALUM'



A recent report on the successful operation of this plant, which was constructed early in 1937, says in part:

"... Applying aluminum sulfate to the primary clarifier effluent (that is, to settled sewage), a dosage of 70 to 80 ppm., or around 4 or 5 grains per gallon is sufficient ordinarily to produce a crystal clear effluent from clarifier No. 2. This effluent, when placed in an Imhoff cone, *cannot be distinguished from tap water* . . ."

In this successfully operated plant, as in a growing number of plants throughout the country, General Chemical Aluminum Sulfate is used because:

- 1 It won out in plant scale tests against other coagulants.
- 2 It is simple to apply, clean, and easy to handle.
- 3 Requires only simple low cost equipment for application.
- 4 It is a year-round coagulant.
- 5 No other chemical is needed to complete the reaction, and there is no problem of properly proportioning two or more chemicals.

6 It was the only coagulant tried which could produce a crystal clear (near zero turbidity) effluent.

7 Alum precipitated sewage sludge digests readily and yields a high gas production.

8 Digested sludge dries quickly and without odor.

General Chemical Company is pleased to extend the cooperation of its engineers to cities and townships who are contemplating plant installations of a nature similar to this successful Ridgewood, N. J. plant. Your inquiries are cordially solicited. Write to

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Vancouver



## GENERAL CHEMICAL ALUMINUM SULFATE

(Continued from page 20)

tion of the A. W. W. A. has been active in evolving and sponsoring the proposed bill. Laurence G. Lenhardt, General Manager of the Detroit Department of Water Supply has been the Section's spokesman. An argument opposing the bill was made by the secretary of the Michigan Building and Loan League.

As a result of the court decision and the failure of the State Legislature to pass a bill, the consumers of Detroit will have to post an aggregate of about \$2,000,000 in deposits to guarantee their water bills, declared Douglas Dow, President of the Detroit Board of Water Commissioners. In addition, according to Mr. Dow, expenses of the Board will increase about \$500,000 in the next year and the probabilities are this will be passed on to the consumer in the form of an 8 per cent increase in rates. Added cost after the system is in operation will be from \$200,000 to \$300,000 per year.

*Wire Flash: Lien Bill Passed in State Legislature.*

The State Board of Accounts in Indiana has ordered the officials of the city water works of Alexandria, Ind., to serve notices upon delinquent

(Continued on page 26)

## For Underground Service Lines

### ANACONDA COPPER and RED-BRASS



Anaconda Copper Tubes in straight lengths and coils... Anaconda "85" Red-Brass in straight lengths only — both are products of dependable quality. Made by the world's largest and most experienced manufacturer of copper and brass, and stocked by leading supply houses.

3924

**THE AMERICAN BRASS CO.**  
General Offices: Waterbury, Connecticut

## COMPLEX or SIMPLE

*All Joints look alike to this  
INGOT Form Compound*

**T**egul-MINERALEAD is used in pipe from 2" diameter up to the largest—and in every size in between. It is easy to use; no skilled labor required; no caulking or deep bell holes needed • Correctly compounded at our plant, no amount of jolting in transit can change composition en route to you • The 10 lb. unit is

easy to handle, ship and store; and impervious to rain and flood

• Tegul-MINERALEAD offers the conceded advantage of sulfur base compounds without their handicaps • Initial leakage heals quickly, permitting immediate clean-up • For further information write the ATLAS MINERAL Products Company of Penna., Mertztown, Pennsylvania.



*Tegul-*

**MINERALEAD**



## *The skill lies not in the scalpel . . .*

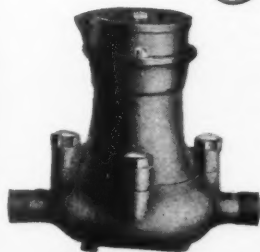
Behind it there must be the trained fingers and steady hands of the skilled surgeon. Behind the modern precision equipment that has set new standards of finish, of closer tolerances and of accuracy in Trident Water Meters lies the skilled workmanship of trained men to whom meter making is a craft. That is one reason why well over 7 million Neptune-made meters have been sold the world over . . . the great majority of which are still in service.



1892

1939

● Neptune Meter Company, 50 West 50th Street (Rockefeller Center), New York City. Branch Offices in Principal Cities. Neptune Meters, Ltd., 345 Sorauren Avenue, Toronto, Canada.



SPLIT CASE TYPE

# TRIDENT WATER METERS

PRECISION BUILT • INTERCHANGEABLE PARTS

# DIRECTORY OF EXPERTS

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struction Supervision, Appraisals and  
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Analysis of the water supplies  
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camps. Swimming pool control.

Chemists Field Sanitary Surveys  
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WATER WORKS - SEWERAGE - UTILITIES

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**THE PITOMETER COMPANY****Engineers**

Water Waste Surveys

Trunk Main Surveys

Water Distribution Studies

Penstock Gaugings

50 Church St.

New York City

*Help Build up Your Association  
by Bringing in a New Member*

SEND FOR  
APPLICATION BLANK

AMERICAN WATER WORKS  
ASSOCIATION

22 East 40th St.

NEW YORK CITY

*(Continued from page 22)*

consumers and to turn off the water unless payments are immediately forthcoming. Delinquents can make arrangements for regular payments in installments on back bills, and as long as these are made and current bills paid on the date due the water will not be turned off. Alexandria has a total of more than \$1,800 in delinquent water bills.

**New construction in Detroit** is proceeding at such a rapid pace that the Department of Water Supply is more than 500 installations behind requests for service, according to Laurence G. Lenhardt, General Manager of the department. The Board of Water Commissioners has approved the employment of 25 additional laborers on a temporary basis in the maintenance department, to make water connections. In the first two weeks in April, 446 requests for water connections were received as compared with 165 for the same period a year ago.

**Citizens' Business**, published by the Bureau of Municipal Research, Philadelphia, Pa., is the source for the following quotation:

"Under the present city charter virtually all the city's capital expenditures since 1919 have been financed through sales of bonds. Not only that, but most of the cost of repaving streets has been similarly financed. It is no wonder, then, that the city's bonded debt has grown to mountainous proportions, and that about 42 cents of each dollar of the city's revenues has to be used for interest, sinking-fund instalments, and state tax on that debt.

*Reasons for Issuing Bonds.* Apart from the purposes for which the money is to be spent, there are two principal reasons for issuing bonds. These are (1) to spread the cost of public improvements and property over the taxpayers who will benefit from such improvements and property and (2) to keep the tax rate down. The first is the more plausible reason. Generally speaking, however, the controlling reason for issuing bonds is

*(Continued on page 28)*

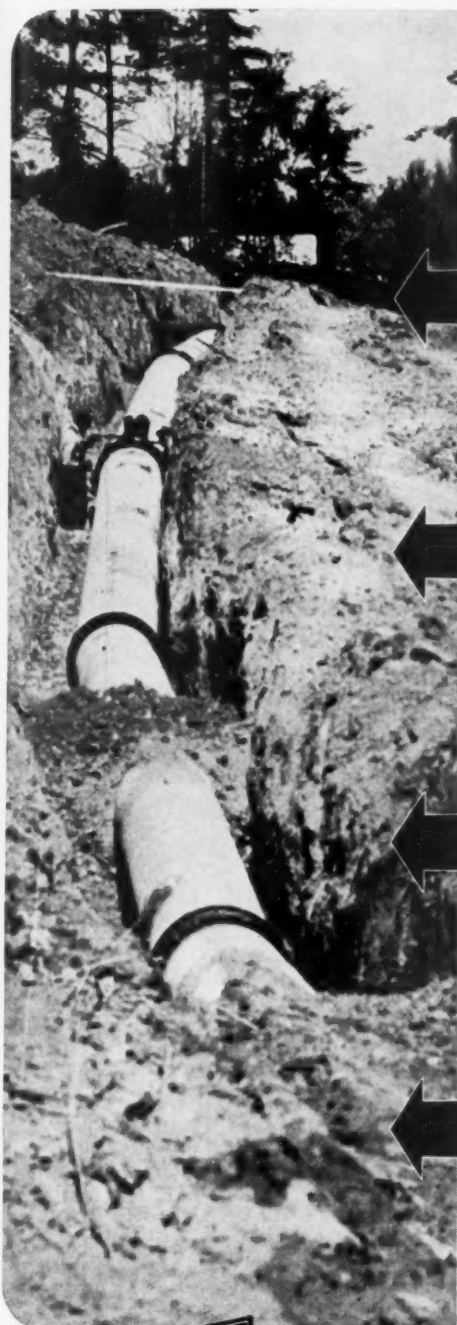
## OUR ZEOLITES—BASEX AND HI-BASEX

**Perfection in highly refined, durable, efficient greensand zeolites for open gravity or closed pressure water softeners.**

*Extensively used with entire satisfaction for over 15 years*

*Send for Details*

**HUNGERFORD & TERRY, Inc., Clayton, New Jersey**  
also manufacturers of the well known INVERSAND water softener



## GIVE YOUR CITY *More Water* AT LESS COST

### Saves Installation Expense

Your water supply lines and force mains will go in faster and more economically when you use Armco Spiral Welded Steel Pipe. Its long lengths (up to 50 feet) reduce handling costs, save up to 108 joints a mile.

### Eliminates Joint Leaks and Breaks

Surveys indicate that many old-style water systems lose from 15 to 25 per cent of daily consumption through joint leaks and breaks. Save this waste and prevent costly repairs by using Armco Spiral Welded Steel Pipe with Dresser Couplings.

### Saves Pipe Cleaning Bills

Tuberculation, resulting in reduced carrying capacity, forces many cities to clean their mains at regular intervals. Yet by specifying Armco pipe with a spun enamel lining, you can avoid this expense, assure higher flow capacity and cut pumping costs.

### Costs Less Per Year

Due to its many economy features, Armco Spiral Welded Pipe can assure your city of more water at lower cost per year of service. Write for the facts. The American Rolling Mill Co., Pipe Sales Division, Middletown, O.

**ARMCO**



**SPIRAL WELDED STEEL PIPE**

APPROVED BY UNDERWRITERS LABORATORIES, INCORPORATED

(Continued from page 26)

to keep the tax rate down, or at least to keep it lower than it would have to be if the expenditures were to be financed initially out of revenues. When the impact of capital expenditures on revenues comes only through the gradual piling up of debt charges, neither officials nor taxpayers are nearly so critical of the way money is spent as when those expenditures are met directly out of revenues.

*Facts Overlooked.* But these reasons ignore some important facts: first, that taxpayers will have to pay, not only the cost of the improvement, but also the interest and state tax on the bonds; second, that those taxpayers will be very largely the same persons who were the taxpayers when the improvement was begun; and, third, that after a short period the annual burden for interest, sinking-fund instalments, and state tax on the bonds issued during that period will equal, and then exceed, the average annual amount of capital expenditures for which bonds were issued.

*Proposed Charter Provision.* Recognizing these generally overlooked facts, and particularly the advantages of a smaller debt, a smaller annual debt burden, and the rapidly increasing saving of interest that would result from meeting capital expenditures directly out of revenues, the Phila-

(Continued on page 30)



## FARNAN CLEVELAND

**TWO WORDS—FARNAN CLEVELAND**—these are all you need to remember to insure your obtaining the highest grade brass stops, couplings and fittings that can be purchased at any price anywhere. **Quality Plus, and Durability Plus, mean Economy Plus.**

**THE FARNAN BRASS WORKS CO.**  
**CLEVELAND**      *ESTABLISHED 1852*      **OHIO**

# MATHIESON *HTH* FOR SAFE BEACHES

Says George R. Young, Village Manager,  
Village of Glencoe, Illinois:

March 7, 1939

"You will be interested in our successful use of HTH on our Lake Michigan Beach. . . Two problems were involved: foot infections from the bacteria in the sand, and insects. . . HTH was tried, using a 2% solution. We were able with this solution sprayed on the sand to reduce the fly egg count from 800 per square inch to almost none. We eliminated bacteria and foot infection completely, so far as we were able to determine. We feel that the added satisfaction and confidence inspired in our Glencoe residents who use the beach was well worth while. . . In the past ten years we have enjoyed excellent service from your company."



- Municipal Bathing Beach, Glencoe, Illinois.
- Filtration Plant, Glencoe, Illinois Waterworks.



**MATHIESON CHLORINE  
FOR SAFE DRINKING WATER**

HTH is a dry, free-flowing chlorine carrier. 70% of its weight is chlorine available for killing bacteria and destroying odors and other objectionable contamination. Its germ-killing power is released rapidly, uniformly — requires no bulky equipment, no specially expert or experienced operator. Best of all HTH really does the job.

Glencoe is only one of the many villages, towns and great cities throughout the country that have found in HTH and Mathieson Chlorine the ideal solution of the problem of water purification, sewage treatment, beach and pool sanitation.

Mathieson Chlorine means a pure, dependable product — safe, trouble-free containers and valves — prompt delivery service. In addition you have available the full cooperation of Mathieson's expert technical staff.

**THE Mathieson Alkali Works (INC)**

60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE...HTH...SODA ASH...CAUSTIC SODA...BLEACHING POWDER...BICARBONATE OF SODA...AMMONIA,  
ANHYDROUS and AQUA...PH-PLUS (FUSED ALKALI)...DRY ICE...LIQUID CARBON DIOXIDE...GYPSUM PRODUCTS

(Continued from page 28)

delphia Charter Commission has included in the proposed new city charter a form of 'pay-as-you-go plan' for financing capital outlays. Modeled somewhat after a similar provision in the charter of New York City, this provision requires the financing out of revenues of an increasing percentage of all capital expenditures, except for self-liquidating projects and those costing over \$10,000,000 each. Thus, in the first year at least 2% of such expenditures must be met out of revenues, in the second year at least 4%, and so on, 2% more each year, until the 50th and succeeding years, when the entire amount must be met out of revenues. That is a most commendable provision. It will apply very gradually, but it should result in huge savings, and in a much sounder financial structure for the city."

Wheeling West Virginia, has put into effect a 20 per cent reduction in service charges for water by order of its Public Service Commission. The surcharge of 50 per cent on operators of swimming pools was eliminated, although the city is allowed to charge a \$2 per month minimum fee while the pools are not in use. Otherwise regular commercial rates apply.

(Continued on page 42)

## ADVERTISING RATES

Journal of the  
AMERICAN WATER WORKS ASSOCIATION

22 EAST 40th STREET

NEW YORK, N. Y.

## 1. GENERAL ADVERTISING

(a)

	1 Month (per issue)	3 Months (per issue)	6 Months (per issue)	12 Months (per issue)
1 page	\$80.00	\$65.00	\$55.00	\$50.00
$\frac{1}{2}$ page	50.00	40.00	35.00	31.00
$\frac{1}{4}$ page	35.00	25.00	20.00	18.00
$\frac{1}{8}$ page	18.00	14.00	11.00	9.00

1/12 page—Professional Card (under special classification only)..... \$3.00

(b, c) No time or space discounts.

(d) Covers and special positions—Yearly basis.

Outside front—no advertising.

Inside back..... \$60.00

Other special positions..... 60.00

Inside front..... 65.00

Outside back..... 90.00

(e) Minimum size of advertisement is  $\frac{1}{8}$  page—2 $\frac{1}{4}$ " long x 1 $\frac{3}{4}$ " deep (except Professional Card—1/12 page under special classification).

(f) Space to be used within one year from date of contract.

Color and insert rates on application.

2. CLASSIFICATIONS—(a, b)—None. (c, d)—Professional Card—1/12 page. Limited to advertisement of professional services. Further information upon request.

## Progress!

Today, if Superintendent in charge of a water or sewerage system, you can sit in your office and "keep your eye on the whole works."

### DISTANT METERING AND SUMMATION

You can read flow through individual distant Venturi Meters, and you can read total flow through all main lines—on Chronoflo Receiving Instrument dials centrally located.

### OUTLYING RESERVOIR AND STANDPIPE LEVELS

You can read the water level in any standpipe or reservoir, no matter how far from headquarters, by glancing at the nearby Indicating and Recording Gauges; saves time-consuming trips or guesswork.

### REMOTE CONTROL OF PUMPING STATIONS

You can set operation of a distant pumping station without leaving your office; Instruments right at your elbow will report back exactly what is taking place.

### MASTER CONTROL OF FILTERS

You can set an entire group of filters through one central Master Controller; or have the level of the clear well take over the control.

### AIR RELAY—KENNISON NOZZLES—RATIO GAUGES

You can measure sewage and sediment-bearing water with Air Relay Transmission. You can measure flow through partially filled pipes with Kennison Nozzles. Flow and Ratio Gauges will contribute effectively to efficiency of sewage treatment.

*You can write for descriptive bulletins*

## BUILDERS IRON FOUNDRY

"Builders of the Venturi Since 1891"

9 Coddling St.

Providence, R. I.

## THEY'RE GOING TO SELL THE WATER WORKS!



"Ridiculous!" you'd say. But there was a time a few generations ago when such an occurrence might have come to pass... because of ignorance of the true value of pure water to the community.

Today, citizens and officials alike recognize the value of pure water... so much so, that they take water purification as a matter of natural course.

They want the best and purest water obtainable. And one way of assuring the maintenance of the accepted high standards of today is to use the best purification materials that can be had.

Solvay Liquid Chlorine is a genuinely high quality product. Extreme care is exercised in its manufacture to insure complete freedom from impurities.

But almost as important as the Liquid Chlorine itself is the organization that stands behind it. Unusual service facilities are at your disposal... a well equipped Technical Service... adequate supplies, and a delivery system that is geared to handle emergency situations. Write for complete information.

### SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by  
The Solvay Process Company

40 RECTOR STREET

NEW YORK, N. Y.



## Another MORSE FILTER PLANT of Steel Construction



The Citizens Water Company recently placed this 720,000 g.p.d. Morse filter plant in operation at New Bethlehem, Pa. It is of welded steel construction with the coagulating basins, filters and pipe vault located in concentric cylinders. Steel construction prevents cracking, eliminates seepage and assures long life. Design your next filter plant in this modern manner.

## CHICAGO BRIDGE & IRON COMPANY

Chicago ..... Old Colony Bldg.  
Birmingham ..... 1500 N. 50th Street  
Boston ..... Consolidated Gas Bldg.  
Cleveland ..... Rockefeller Bldg.  
Dallas ..... Liberty Bank Bldg.  
Detroit ..... Lafayette Bldg.

Houston ..... 2919 Main Street  
Los Angeles ..... Wm. Fox Bldg.  
New York ..... 165 Broadway Bldg.  
Philadelphia ..... 1700 Walnut Street Bldg.  
San Francisco ..... Rialto Bldg.  
Tulsa ..... Hunt Bldg.

Plants at BIRMINGHAM, CHICAGO and GREENVILLE, PA.

(Continued from page viii)

- LANDGRAF, GEO. F. Water Dept. Engr., City Hall, Royal Oak, Mich.  
LEH, WILLARD. (Employed by Veterans Admin., Washington, D. C., in san. Eng. work on water supply, sewage disposal and public health eng.), 1376 Perkiomen Ave., Reading, Pa.  
LEONARD, W. V. San. Engr., Division of Health, Boise, Idaho.  
LUBOW, LOUIS A. Chemist, Water Dept., 815 Cleveland St., Durham, N. C.  
MOORE, CARL C. Salesman, Pittsburgh Equitable Meter Co., 243 N. 51st St., Columbus, Ohio.  
MOORE, TOM F. Salesman, General Chemical Co., 12047 Lake Ave., Lakewood, Ohio.  
NEILL, HAROLD D. Sales Representative, American Rolling Mill Co., Middletown, Ohio.  
NICKLIS, JAMES A. Dist. Representative, Wallace & Tiernan Co. Inc., 1697 Wyandotte Rd., Columbus, Ohio.  
O'DAY, GEO. P. Dist. Sales Representative, James B. Clow & Sons., 2452 Superior Viaduct, Cleveland, Ohio.  
POTTER, H. N. Chemical Engr., Dearborn Chemical Co., 2454-2464 Durdas St. W., Toronto, Ont., Canada.  
RALLS, W. E. Supt., Trenton Mun. Utilities, Trenton, Mo.  
RAMSEIER, R. E. Resident Engr., Decoto San. Dist., 363 Winton Ave., Hayward, Calif.  
RECIO, JERONIMO ACOSTA. Engr. Direccion General, Secretaria de Obras Publicas, Edificio America, Calle N. 408, Vedado, Havana, Cuba.  
REED, I. H. Vice-Pres. & Treas., Sedalia Water Co., 111 W. 4th Street, Sedalia, Mo.  
RODRIGUEZ-VICENTINI, CESAR. San. Engr., Ministerio de Obras Publicas, Avenida Sur 81, Caracas, Venezuela, S. A.  
SMITH, DAVID R. Director, Dept. of Works, 38 Wentworth St., St. John, N. B., Canada.

(Continued on page 36)

**APPLICATION FOR MEMBERSHIP  
IN THE  
AMERICAN WATER WORKS ASSOCIATION  
22 East 40th Street, New York, N. Y.**

Date:.....

.....hereby make application for  
(I or We)

.....  
(Active, Junior, Corporate or Associate Membership, or Affiliate)

in the American Water Works Association, and enclose herewith the sum of  
\$....., one year's dues in advance.

Name.....

Company or Department.....

Title or Position.....

Address.....

.....  
If application is for Junior Membership, give date of birth.....

If application is for Affiliate, state number of active services in property where em-  
ployed .....

Nature of business or character of work (for office records).....

.....  
If application is for Corporate or Associate Membership, it must be signed by the  
person designated to represent the firm or corporation in A.W.W.A. activities.

.....  
*Signature of Applicant*

(over)

## ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, \$10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, \$15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, \$25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, \$5.00.)

Section 7. An affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, \$4.00.)

---

Memberships will be dated as of the beginning of the quarter in which the application is received.

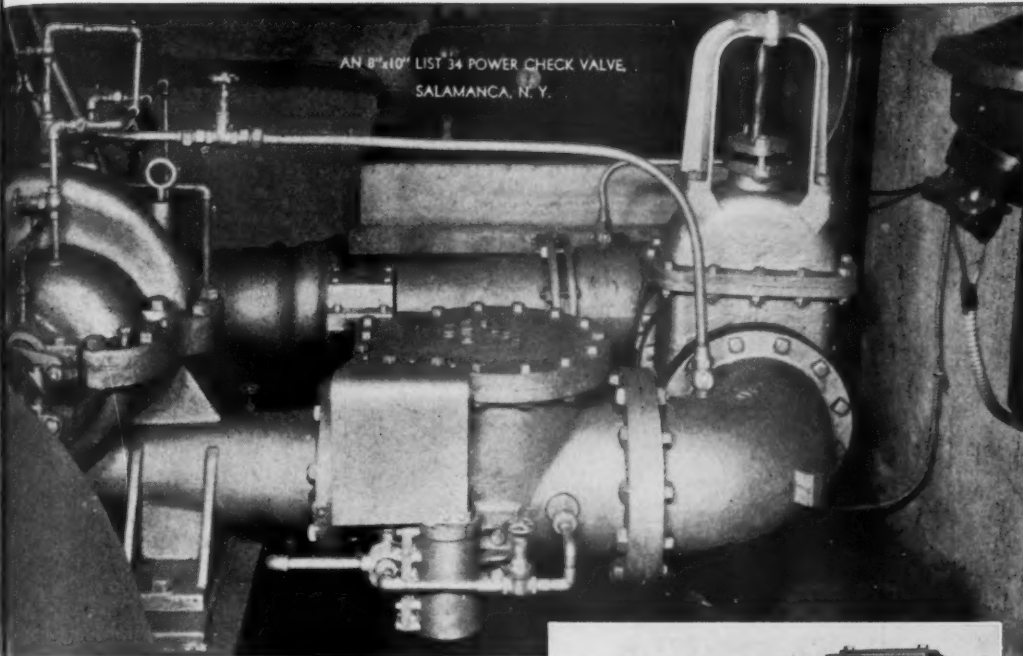
Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

FOR QUIET CLOSURE & MAXIMUM EFFICIENCY-INSTALL

# RENSSELAER

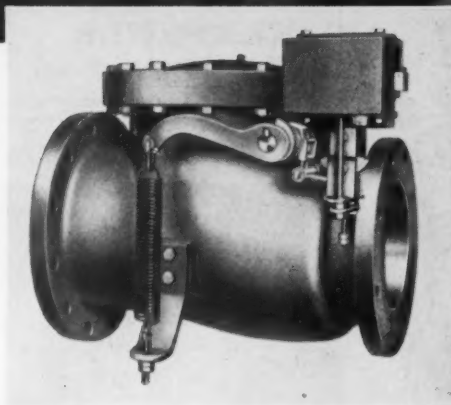
LIST 34 POWER CHECK VALVES

AN 8"x10" LIST 34 POWER CHECK VALVE,  
SALAMANCA, N. Y.



- Positively eliminates slam on pump shut-down.
- Full clearway opening reduces head loss and cuts power costs.
- Simplicity of design and rugged construction results in trouble-free operation over a period of years.

Bulletin "V" mailed on request



RENSSELAER VALVE COMPANY, TROY, N. Y.

(Continued from page 32)

- SMITH, MURRAY M. Village Engr., 60 Hardy Road, Village of Grosse Pointe Farms, Mich.  
 TALLON, E. P. Supt., Dominguez Water Corp., R. 2, Box 215, Long Beach, Calif.  
 VICENTINI, G. JORGE. San. Engr., Ministerio de Obras Publicas, Aptdo. No. 304, Caracas, Venezuela, S. A.  
 WATSON, ROBT. G. Power Supt., Power-Plant & Waterworks Dept., Edmonton, Alta., Canada.  
 WILSON, J. B. Vice Pres., Illinois Water Service Co., Room 924, 208 La Salle St., Chicago, Ill.  
 WOLCOTT, HERBERT. Wolcott Water Softeners, 610 Range Line St., Columbia, Mo.  
 WRAIGHT, ALAN F. A. Asst. Chief Clerk, York Township Water Revenue Dept., 155 King St. E., Toronto, Ont., Canada.

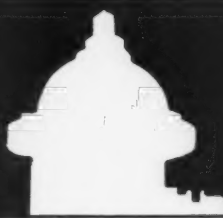
*Corporate Members.*

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 HOME WATER DISTRICT. Mr. E. Riley, Supt., Multnamoh, Ore.  
 NEENAH CITY WATER WORKS. Mr. A. Hanson, Chemist, Neenah, Wis.  
 CITY OF SALEM WATER DEPT. Mr. William F. Ayars, Supt., Municipal Bldg., Salem, N. J.

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- F. S. BRAINARD CO. Mr. Frank S. Brainard, Jr., Vice Pres., 246 Palm St., Hartford, Conn.  
 LYDEN & McFARLIN. Mr. R. Burke Lyden, Sales Mgr., P. O. 1294, Youngstown, Ohio.  
 WATEROUS COMPANY. Mr. Fred A. Waterous, St. Paul, Minn.

(Continued on page 38)



**KUPFERLE**  
**FIRE HYDRANT NO. 100**  
 approved by Fire Underwriters and  
 complying with specifications  
 of the A.M. W. W. ASSN.  
 Write for specification sheets.

**John C. Kupferle**  
**FOUNDRY CO.**  
 St. Louis

**The Ford Resetter**  
 AN IDEAL FITTING for RAISING  
 TOO-LOW METERS EASILY

Connects  
 between  
 old meter  
 couplings.



Durable.—  
 all brass and  
 copper.

Improve your old meter settings by installing the RESETTER. Bring your water meters up out of the mud and water so that they are easier to read and take care of. Write for catalog.

**The Ford Meter Box Co.**  
 WABASH, INDIANA

# A RECORD FROM SEATTLE



A 6 inch

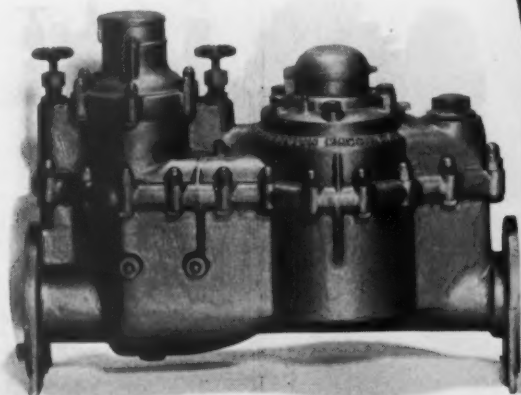
## HERSEY COMPOUND METER

was installed about the end of 1934 by the Seattle Water Dept. as a master meter for Water District No. 7. After registering 465,000,000 gallons, the meter recently tested  $\frac{1}{2}$  of 1% less than when first installed. The officials considered this a very satisfactory performance.

### HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK—PORTLAND, ORE.—PHILADELPHIA—ATLANTA—DALLAS—CHICAGO  
SAN FRANCISCO—LOS ANGELES



**COOK**  
Well  
Strainers

( A reciprocal relation, the life and functioning of the one depending much on the other. )

( **A. D. COOK, INC.**  
**Lawrenceburg - Indiana** )

**COOK**  
Deep-Well  
Turbine  
Pumps

(Continued from page 36)

*Affiliates.*

CASE, E. W. Supt., Newport Water Dept., Newport, Ore.  
DRISKELL, THOS. E. Chemist, Water Dept., 1005 W. Race St., Troy, Ohio.

*Reinstatements (Active)*

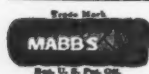
ANDERSON, S. T. 547 So. Park Ave., Springfield, Ill.  
CLARK, WILLIAM GEORGE. Supervising Construction Engr., Div. of Water, 110 Cherry St., Toledo, Ohio.  
EASTERDAY, E. E. Division Engr., St. Louis Water Division, 1640 So. Kingshighway, St. Louis, Mo.  
LARKINS, T. H. Supt. of Filtration-City Chemist, Box 497, 316 Thompson Ave., East Liverpool, Ohio.  
LUNDQUIST, HARRY. Salesman, Neptune Meter Co., 5228 Brookview Avenue, Edina, Minneapolis, Minn.  
KELSO, GILBERT L. West Virginia Public Health Training Center, Morgantown, W. Va.  
MCMILLAN, L. S. Supt., Water Works, Raeford, N. C.  
MCMURRY, W. F. 405 City Hall, Tulsa, Okla.  
MILLER, F. C. City Chemist, Trinidad, Colo.  
SHOEMAKER, WM. C. Asst. Mgr., Richmond Water Works Corp., Richmond, Ind.

*Resignations (Active)*

HOWLAND, J. HASTINGS. Engr., National Board of Fire Underwriters, 85 John St., New York, N. Y.  
HUGGANS, R. D. Manager, Water Works, Streator, Ill.  
KITCHEN, H. B. Mgr., Watsonville City Water Works, 268 Main St., Watsonville, Calif.  
MARLER, FRED. Water Supt., Colfax, Wash.  
MCARTHUR, J. W. Gen. Supt.-Secy., Eugene Water Board, City Hall, Eugene, Ore.  
REID, W. M. Supt. Water Supply, P. O. Box 114, Canton, Miss.  
WRIGHT, LORIN O. Filter Operator & Chemist, City Water, Light & Power Dept., 1516 S. Spring St., Springfield, Ill.

*Section Transfers—April, 1939*

L. H. CHAMBERLAIN from California to Illinois.  
A. T. COOK, from New Jersey to Missouri Valley.  
PAUL A. DIEHL, from Rocky Mountain to Missouri Valley.  
FREDERICK H. WEED, from Western Pa. to Four States.  
WATSON, A. DARK, from Illinois to Four States.  
FRED E. STUART, from New York to Four States.  
TATE PIPE LININGS, INC., from New York to New England.



PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

## MABBS RAWHIDE PACKING

on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

Why not use it in your plant and benefit thereby?

MABBS HYDRAULIC PACKING COMPANY, Inc. 1892, 431 S. Dearborn St., Chicago, Ill.



# P-D-M MUNICIPAL HEADQUARTERS for ELEVATED TANKS

P-D-M Elevated Steel Tanks are supplied in all sizes, from 5,000 gals. to 5,000,000 gals. capacity.

P-D-M Products for the American Municipality include: Elevated Steel Tanks . . . Water Reservoirs . . . Water Refusing Plants . . . Steel Incinerators . . . Swimming Pools . . . Steel Grandstands. Bulletins gladly sent on request.



● Pittsburgh-Des Moines' high place in the regard of the many municipalities who have invested in P-D-M Elevated Steel Tanks is maintained by the sterling performance and lifetime durability of these famous products. The thousands of P-D-M Tanks serving villages, towns and cities throughout America prove to everyone's satisfaction that P-D-M's "know how" is unsurpassed in modern tank design, fabrication and erection.

If improvement is desirable in your own community's water service, it will cost not a whit to have a skilled Pittsburgh-Des Moines Engineer make a preliminary survey of the problem. His broad experience has been gained in dealing with similar needs in like communities—and he will be glad to detail to you and other interested local authorities how P-D-M Elevated Water Storage assures continuous water supply at uniform pressures throughout the day and year . . . how it lowers operating costs, and *betters* service for every consumer.

Let us arrange a consultation for you—and meanwhile, send you our informative 20-page bulletin on "Modern Water Storage in Elevated Steel Tanks." No obligation, of course!

## PITTSBURGH • DES MOINES STEEL CO.

PITTSBURGH, PA. 3424 NEVILLE ISLAND—DES MOINES, IOWA. 925 TUTTLE STREET

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Dallas, 1229 Praetorian Building . . . San Francisco, 631 Rialto Building

KEEP THE WATER SUPPLY

*Pure*

WITH THE PENNSYLVANIA SALT  
SYSTEM OF SAFETY



The illustration depicts a domestic scene at a kitchen sink. A woman with dark hair, wearing a light-colored dress and a dark apron, is smiling as she turns a faucet handle with her right hand and holds a glass under the running water with her left. To her right, a young girl with a headband is drinking from a glass. In the foreground, the back of a young boy's head is visible as he watches the woman. The background features a simple wall and a sink.

**Liquid Chlorine ★ Perchloron**



Two notable products now work together to help you safeguard the water supply of your community. One is liquid chlorine so pure that it materially reduces operating difficulties. The second is Perchloron, which acts as a second line of defense in time of emergency. Both together give you a *System of Safety* that is almost unailing.

The liquid chlorine supplied by this Company is a great advance in purity, for it is virtually free from organic impurities. This is made possible by a new purifying process developed by Pennsylvania Salt which reduces trouble-making substances to so low a point that even their cumulative effect over long periods of operation can scarcely be traced.

As a further safeguard, a new means of manufacturing control was developed—an improved analytical method of evaluating chlorine as to troublesome impurities. Every available means has been used to provide you with a product that minimizes the formation of "taffy". You are certain to find this a superior liquid chlorine.

#### **If ever your chlorine supply fails . . .**

If normal conditions were the only ones possible, you would never need to prepare for emergencies. But a hurricane, a blizzard, a flood, or a tremendous fire, may tie up transportation and deprive you of normal supplies of liquid chlorine. That is when you will appreciate Perchloron.

With an available chlorine content of over 70%, Perchloron is a dependable source of chlorine in emergency. It is stable,

concentrated, uniform. Dissolves readily in water. Packed 12 handy cans to the case, each can with punch-and-pry-up top. Also in 75 lb. drums.

It is convenient and economical, not only for emergency chlorination, but for sterilizing new mains, for clear wells and filters, and for swimming pool sanitation. Write for free booklet today. Pennsylvania Salt Manufacturing Co., Widener Bldg., Philadelphia, Pa.—New York • Chicago • St. Louis • Pittsburgh • Tacoma • Wyandotte.



**PENNSYLVANIA SALT**  
MANUFACTURING COMPANY  
*Chemicals*

(Continued from page 30)

An increase of 6,100 miles of water mains and distribution systems and 8,900 miles of storm and sanitary sewers over the number of such facilities existing in 1935 is shown by a recent summary of the physical accomplishments of the Works Progress Administration during the first three years of its existence.

The report shows that workers taken off relief rolls constructed, on WPA projects, 6,086 miles of new water mains, aqueducts or distribution lines, with 148,000 consumer connections, and improved 2,204 miles with 201,000 consumer connections. They built 1,342 storage tanks, reservoirs and cisterns with total capacity of 716,500,000 gallons and improved another 358 with aggregate capacity of 16,269,946,000 gallons. They constructed 4,091 storage dams and improved 469, and dug 2,059 wells while improving 2,022 more.

A total of 429 treatment tanks were built, and 346 improved, of which 315 were new sewage plants, exclusive of cesspools and septic tanks, 79 were new water treatment plants, and 35 were garbage incinerators, while 229 represented improvement of sewage plants, 91 improvement of water treatment tanks, and 26 improvement of garbage incinerators.

(Continued on page 43)



## STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains—under paved streets, railroads or over bridges—you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

### HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church Street, New York, N. Y.  
General Offices and Works: West Medford Station, Boston, Mass.



A Symbol  
of  
Quality

# HYDRO-TITE

Reg. U.S. Pat. Off.

A DEPENDABLE SELF - CAULKING JOINT COMPOUND

(Continued from page 42)

WPA crews constructed 386 new pumping stations and improved 179; built 8,855 miles of new storm and sanitary sewers with 220,000 consumer connections while improving 2,600 miles with 28,000 connections; and built 237,000 new manholes and catch basins while improving 126,000. Workmen of WPA built 1,144,000 sanitary toilets and improved 15,000; built 5,570 septic tanks and improved 69; and sealed 115,486 openings in abandoned mines.

Squads of relief workers used 1,422,000 gallons of spray in mosquito control work, which involved excavation of 8,732 miles of ditch and the drainage of 1,642,000 acres. They also excavated 2,018 miles of ditch and laid 986 miles of pipe to drain 2,891,000 acres on projects exclusive of roadside drainage and mosquito eradication.

Drainage work along roads involved 313,000 new culverts, 22,250 miles of new ditches, 44,250 miles of improved drainage and the laying of 1,382 miles of pipe.

The WPA mine sealing program is claimed to have reduced acid pollution in Ohio River Basin 25 per cent. On the basis of field reports summarizing accomplishments of the program up to December 31, 1938, it is estimated that sulfuric acid drainage from all coal mines, active and

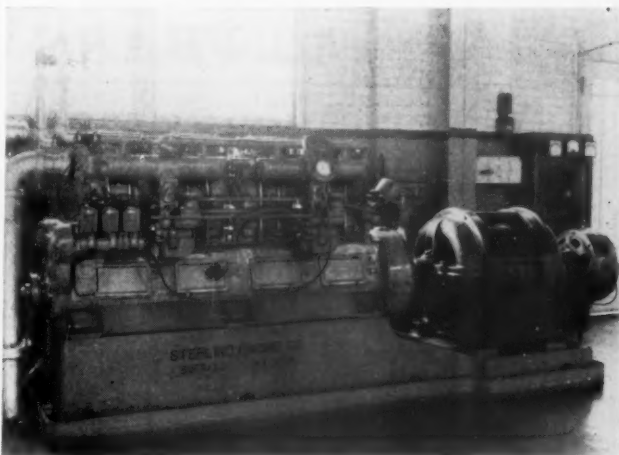
(Continued on page 44)

## BRYAN, OHIO, *Emergency Generator Set*

Standby power for air compressor required for starting large Diesel Engines.



Sterling  
High  
Duty  
Internal  
Combustion  
Engines



125 K.W. 1200 R.P.M. General Electric Generator direct connected to Sterling Dolphin C 8-cylinder 240 H.P. gasoline engine.

For over 20 years Sterling gasoline engines have been the accepted standard for emergency.

Free consultation invited.

**STERLING ENGINE COMPANY • Dept. C-3**

Home Office and Plant, 1270 Niagara Street,  
Buffalo, New York

Branch Office, 900 Chrysler Bldg.,  
New York, N. Y.

*(Continued from page 43)*

inactive, in the Ohio River Basin has been reduced 25 per cent in the last six years. In individual regions, acid pollution of streams and rivers has been reduced as much as 90 per cent by sealing abandoned mines and restricting the flow of acid from those still in active operation.

Officials of the U. S. Public Health Service, who have cooperated with state health agencies in the direction of the WPA mine sealing program, estimate that more than 2,000,000 tons of free sulfuric acid flow annually into the Ohio River from its tributaries in the coal mining regions of Pennsylvania, Ohio, Kentucky, and West Virginia. Damage to boats, dams and locks, public water systems, industrial steam raising equipment, and to the streams themselves and their adjacent lands, is placed at more than \$10,000,000 a year, a sum far in excess of the total cost to date of WPA's remedial measures.

The WPA mine sealing program has been in operation since the fall of 1935. As of the end of 1938, according to reports submitted to Colonel Harrington, a total of 4,123 mine sealing units had been completed. This involved the closing of more than 115,000 principal drifts, air shafts, surface breaks and other incidental openings to exclude air and water

*(Continued on page 45)*

## THE STANDARD

*for more than*  
**50 YEARS**

### WATER WORKS SPECIALTIES



**Automatic Pressure Control  
Valves**

**Pressure Reducing-Altitude  
Surge-Relief and Combination  
Valves**

**Portable Fire Hydrants**

**Hydraulic Booster Pumps**

**ROSS VALVE MFG. CO., INC. TROY, N. Y.**

*(Continued from page 44)*

from the mines. Overall cost of the program in that period was \$6,367,096 provided chiefly out of WPA funds. Employment has been furnished several thousand jobless miners, the only type of workmen experienced enough to undertake such hazardous work.

A study made by the National Resources Committee placed the annual burden of sulfuric acid generated in coal mines and discharged into streams at 2,300,000 tons and recommended an expenditure of \$12,000,000 as the minimum necessary for the completion of the mine sealing program. While active mines contribute a certain amount of acid, more than 60 per cent of this form of pollution in the Ohio River Basin originates in old mines which have been worked out and abandoned. It is estimated that there are 16,000 such abandoned "acid factories" in the four-state region, and it is toward these that the WPA mine sealing program is directed.

Sulfuric acid of a high degree of concentration forms in coal mines through the action of air and water on the mineral pyrites present in all coal veins. As seepage water accumulates in a mine and flows or is pumped to the outside, it carries this acid with it in solution. Oxygen is

*(Continued on page 46)*

## CLEAN YOUR WATER MAINS

One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

### National Water Main Cleaning Co.

50 Church St., New York, N. Y.

#### BRANCHES

115 Peterboro St., Boston, Mass.  
910 William-Oliver Bldg., Atlanta, Ga.  
7103 Dale Ave., St. Louis, Mo.  
208 E. Forsyth St., Jacksonville, Fla.

3812 Castellar St., Omaha, Neb.  
2587 Glen Echo Drive, Columbus, Ohio  
501 Howard St., San Francisco, Calif.  
58 Pelham Ave., Toronto, Canada.

(Continued from page 45)

necessary in the chemical reaction which produces sulfuric acid in coal mines. Water alone will not do it. Hence, if air is excluded from the mine, the acid will not form. This is the principle on which mine sealing is based.

Abandoned mines are first surveyed to determine the number and location of all portals, air shafts, cave-ins, and other openings through which air might enter. There frequently are as many as 100 to a single mine. Each of these must be closed. At the principal entry to the mine a brattice, or masonry wall, is built, completely sealing the opening on all sides with the exception of a small aperture at the bottom. A water trap is then constructed around this aperture which resembles an open box about three feet square with the top edge a foot or two above the level of the aperture. This permits the accumulated water to flow out of the mine but prevents air from flowing in. In time, the air sealed within the mine exhausts its oxygen and as no appreciable quantities of new air can enter, acid production ceases.

Ordinarily, from six months to a year are required before a change from acid to alkaline is noted in the waters issuing from a sealed mine. Many individual cases have been recorded, however, in which the change occurred within two or three months. The water seldom becomes wholly alkaline, but the usual reduction in acid content of from 50 to 90 per cent following a successful sealing is sufficient to make the streams usable again for drinking and other purposes.

The following table shows accomplishments and expenditures on the mine sealing program by states from September, 1935, through December, 1938.

STATE	ACCOMPLISHMENTS			TOTAL EXPENDITURES (A)	EST. FLOW ACID PER YR. IN TONS (A)
	Complete Mine Units Sealed (A)	No. Opening Sealed (B)	No. Mines Surveyed (A)		
Alabama.....	66	1,188	160	\$137,113	199,450
Illinois.....	—	—	112	2,215	80,000
Indiana.....	142	2,480	327	207,198	116,463
Kentucky.....	696	3,767	1,552	338,472	401,030
Maryland.....	24	500	444	101,062	38,884
Ohio.....	2,125	49,137	4,289	1,791,452	400,469
Pennsylvania.....	635	50,975	6,737	2,813,538	1,059,409
West Virginia.....	435	7,439	3,461	976,038	506,348
Total.....	4,123	115,486	17,082	\$6,367,096	2,802,053

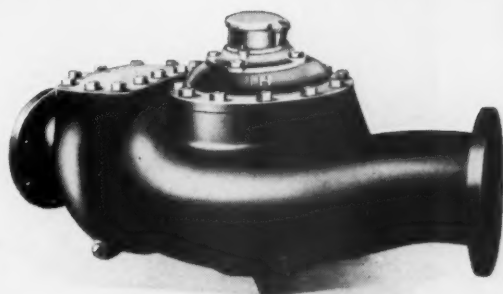
(A) Source: U. S. Public Health Service.

(B) Source: WPA—Covers period through June 30, 1938.

## WATCH DOG METERS



*Frost-proof  
meter*



*Turbine meter*

### Investigate these meters

WHEN looking over your requirements, remember that thousands of municipalities are getting satisfactory low-cost service from Worthington-Gamon Meters.

**WORTHINGTON-GAMON METER COMPANY**

General Offices: HARRISON, NEW JERSEY

*Offices and Representatives in Principal Cities*

## WORTHINGTON-GAMON

# SMITH

## FEDERAL WATER METERS



## Halve Water Consumption with Accurate Meters

**S**MITH water meters are "aces high" with water works men who want a constant dependable check on their water revenues. Precision-built of carefully tested materials, these meters will serve for years without attention. In the SMITH line you will find DISC, CURRENT, DISC-COMPOUND, CURRENT COMPOUND METERS and CONTROLLING VALVES, HEAVY DUTY FEDERAL FROST-PROOF and STANDARD FEDERAL FROST-PROOF, SOLID or SPLIT CASE, OPEN or OIL ENCLOSED GEAR TRAINS.

**The A. P. Smith Manufacturing Company**

East Orange, New Jersey

Smith Tapping Machines—Tapping Sleeves and Valves—O'Brien Hydrants—Valve-Inserting Machines—Removable Plugs, Pipe Cutting Machines—Corporation Tapping Machines—Gas Tee-Inserting Machines—Corporation Cocks—Federal Water Meters

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  - Ludlow Valve Mfg. Co.
  - Mueller Co.
  - Rensselaer Valve Co.
  - A. P. Smith Mfg. Co.
- Engineers and Chemists.**
  - Cliffs Dow Chemical Co.

(See Directory of Experts, page 24)
- Feed Water Filters:**
  - American Water Softener Co.
  - Everson Mfg. Co.
  - Graver Tank & Mfg. Co., Inc.
  - Hungerford & Terry, Inc.
  - International Filter Co.
  - Permutit Co.
  - Ross Valve Mfg. Co.
- Feed Water Heaters:**
  - Worthington Pump & Mach. Corp.
- Feed Water Testing Outfits:**
  - Hellige, Inc.
- Feed Water Treatment:**
  - American Water Softener Co.
  - Everson Mfg. Co.
  - Graver Tank & Mfg. Co., Inc.
  - Hungerford & Terry, Inc.
  - International Filter Co.
  - Permutit Co.
  - Proportioners, Inc.
- Filters and Water Softening Plants**
  - American Water Softener Co.
  - Chicago Bridge & Iron Company
  - Everson Mfg. Co.
  - Fuller & Everett
  - Graver Tank & Mfg. Co., Inc.
  - Hungerford & Terry, Inc.
  - International Filter Co.
  - Permutit Co.
  - Pittsburgh-Des Moines Steel Co.
- Filtration Plant Equipment:**
  - American Water Softener Co.
  - Builders Iron Foundry
  - Chicago Bridge & Iron Company
  - Difco Laboratories
  - Everson Mfg. Co.
  - Graver Tank & Mfg. Co., Inc.
  - Hungerford & Terry, Inc.
  - International Filter Co.
  - Mueller Co.
  - Permutit Co.
  - Pittsburgh-Des Moines Steel Co.
- Filtration Sand:**
  - American Water Softener Co.
  - Dawes Silica Mining Co.
  - Hungerford & Terry, Inc.
  - International Filter Co.
  - Permutit Co.
- Fittings, Copper Pipe:**
  - Crane Co.
  - Dresser Mfg. Co.
  - Farnan Brass Works Co.
  - Kennedy Valve Mfg. Co.
  - Kitson Co.
  - Mueller Co.
- Fittings, Tees, Ells, etc.:**
  - Builders Iron Foundry
  - Cast Iron Pipe Research Assn.
  - Crane Co.
  - Dresser Mfg. Co.
  - Grinnell Co.
  - Kennedy Valve Mfg. Co.
  - Kitson Co.
  - United States Pipe & Foundry Co.
  - R. D. Wood Co.
- Flexible Joints:**
  - Cast Iron Pipe Research Assn.
  - Central Foundry Co.
  - Crane Co.
  - Dresser Mfg. Co.
  - United States Pipe & Foundry Co.
  - Warren Foundry & Pipe Corp.
  - R. D. Wood Co.
- Flumes, Steel:**
  - Alco Products Div., Am. Loco. Co.
  - Chicago Bridge & Iron Company
  - Graver Tank & Mfg. Co., Inc.
  - Pittsburgh-Des Moines Steel Corp.
  - S. Morgan Smith Co.
- Furnaces:**
  - Mueller Co.
  - A. P. Smith Mfg. Co.
- Gages, Surface, Reservoir and Special Water Works:**
  - American Water Softener Co.
  - Builders Iron Foundry
  - The Foxboro Company
  - International Filter Co.
  - Wallace & Tiernan Co., Inc.
- Gas Engines:**
  - Worthington Pump & Mach. Corp.
- Gasholders:**
  - Chicago Bridge & Iron Company
  - Pittsburgh-Des Moines Steel Co.
- Gates, Shear and Sluice:**
  - Crane Co.
  - Ludlow Valve Mfg. Co.
  - Mueller Co.
  - R. D. Wood Co.

- Gears, Speed Reducing:**  
 DeLaval Steam Turbine Co.  
 Worthington Pump & Mach. Corp.
- Goosenecks (with or without Corporation Stops):**  
 Farnan Brass Works Co.  
 Grinnell Co.  
 Kitson Co.  
 Mueller Co.  
 A. P. Smith Mfg. Co.
- Greensand (Zeolite):**  
 American Water Softener Co.  
 Hungerford & Terry, Inc.  
 International Filter Co.  
 Permutit Co.
- Hose, Suction and Discharge:**  
 Edson Corp.
- Hydrants, Fire:**  
 A. D. Cook, Inc.  
 Kennedy Valve Mfg. Co.  
 John C. Kupferle Foundry Co.  
 Ludlow Valve Mfg. Co.  
 Mueller Co.  
 Rensselaer Valve Co.  
 Ross Valve Mfg. Co.  
 A. P. Smith Mfg. Co.  
 R. D. Wood Co.
- Hydrants, Sprinkling and Flushing:**  
 Kennedy Valve Mfg. Co.  
 Ludlow Valve Mfg. Co.  
 Mueller Co.  
 Rensselaer Valve Co.  
 A. P. Smith Mfg. Co.  
 R. D. Wood Co.
- Hydrant Protectors:**  
 Edson Corp.
- Hydraulically Operated Gate Valves:**  
 Crane Co.  
 International Filter Co.  
 Kennedy Valve Mfg. Co.  
 Ludlow Valve Mfg. Co.  
 Mueller Co.  
 Rensselaer Valve Co.  
 A. P. Smith Mfg. Co.  
 R. D. Wood Co.
- Hydrogen Ion Equipment:**  
 Hellige, Inc.  
 Wallace & Tiernan Co., Inc.
- Indicators, Combustion, CO<sub>2</sub>, NH<sub>3</sub>, So<sub>2</sub>, etc.:**  
 Permutit Co.  
 Wallace & Tiernan Co., Inc.
- Inserting Machines:**  
 A. P. Smith Mfg. Co.
- Iron Removal Plants:**  
 American Water Softener Co.  
 Everson Mfg. Co.  
 Graver Tank & Mfg. Co., Inc.  
 Hungerford & Terry, Inc.  
 International Filter Co.  
 Permutit Co.  
 Pittsburgh-Des Moines Steel Co.
- Jointing Materials:**  
 Atlas Mineral Products Co.
- Crane Co.  
 Hydraulic Development Corp.  
 Leadite Co., Inc.  
 Mueller Co.
- Lime Putty Plants:**  
 Chicago Bridge & Iron Company
- Lime Slakers and Feeders:**  
 Graver Tank & Mfg. Co., Inc.  
 Permutit Co.  
 International Filter Co.
- Machines, Drilling:**  
 Mueller Co.
- Machines, Lead Flanging:**  
 Mueller Co.
- Meters:**  
 Buffalo Meter Co.  
 Builders Iron Foundry  
 The Foxboro Company  
 Hersey Mfg. Co.  
 National Meter Co.  
 Neptune Meter Co.  
 Pittsburgh Equitable Meter Co.  
 A. P. Smith Mfg. Co.  
 Thomson Meter Corp.  
 Worthington-Gamon Meter Co.
- Meters (Venturi Type):**  
 Builders Iron Foundry  
 The Foxboro Company  
 International Filter Co.
- Meter Boxes:**  
 Ford Meter Box Co.  
 Mueller Co.  
 Pittsburgh Equitable Meter Co.
- Meter Couplings:**  
 Buffalo Meter Co.  
 Crane Co.  
 Dresser Mfg. Co.  
 Farnan Brass Works Co.  
 Hersey Mfg. Co.  
 Mueller Co.  
 National Meter Co.  
 Pittsburgh Equitable Meter Co.  
 A. P. Smith Mfg. Co.  
 Thomson Meter Corp.  
 Worthington-Gamon Meter Co.
- Meter Coupling Yokes:**  
 Ford Meter Box Co.  
 Mueller Co.
- Meter Reading and Record Books:**  
 Buffalo Meter Co.
- Meter Testers:**  
 Buffalo Meter Co.  
 Ford Meter Box Co.  
 Hersey Mfg. Co.  
 Mueller Co.  
 National Meter Co.  
 Neptune Meter Co.  
 Pittsburgh Equitable Meter Co.
- Meter Washers:**  
 Mabbs Hydraulic Packing Co.
- Oil Engines:**  
 Worthington Pump & Mach. Corp.
- Packing, Rawhide:**  
 Mabbs Hydraulic Packing Co.

**Pavement Breakers:**

Worthington Pump & Mach. Corp.

**Penstocks, Steel:**

Alco Products Div., Am. Loco. Co.  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.  
S. Morgan Smith Co.

**Pipe, Asbestos-Cement:**

Crane Co.  
Johns-Manville Corp.  
Keasbey & Mattison Co.

**Pipe, Brass:**

American Brass Co.  
Crane Co.

**Pipe, Cast Iron (and Fittings):**

American Cast Iron Pipe Co.  
Cast Iron Pipe Research Assn.  
Central Foundry Co.  
Crane Co.  
Grinnell Co.  
United States Pipe & Foundry Co.  
Warren Foundry & Pipe Corp.  
R. D. Wood Co.

**Pipe, Cement Lined:**

American Cast Iron Pipe Co.  
Cast Iron Pipe Research Assn.  
Central Foundry Co.  
United States Pipe & Foundry Co.  
Warren Foundry & Pipe Corp.  
R. D. Wood Co.

**Pipe Coatings and Linings:**

Cast Iron Pipe Research Assn.  
Reilly Tar & Chemical Co.

**Pipe, Concrete:**

Lock Joint Pipe Co.

**Pipe, Copper:**

American Brass Co.  
Crane Co.  
Farnan Brass Works Co.  
Mueller Co.

**Pipe Cutting Machines:**

Crane Co.  
A. P. Smith Mfg. Co.

**Pipe Jointing Materials:**

(See Jointing Materials)

**Pipe Joints, Mechanical:**

Cast Iron Pipe Research Assn.  
Crane Co.  
Dresser Mfg. Co.

**Pipe, Lead Lined (and Fittings):**

Crane Co.

**Pipe, Pressure, Riveted and Welded:**

Alco Products Div., Am. Loco. Co.  
Chicago Bridge & Iron Company  
Crane Co.  
Pittsburgh-Des Moines Steel Co.

**Pipe, Steel:**

Alco Products Div., Am. Loco. Co.  
American Rolling Mill Co.  
Chicago Bridge & Iron Company  
Crane Co.  
Pittsburgh Des Moines Steel Co.

**Plugs:**

A. P. Smith Mfg. Co.

**Potentiometers:**

The Foxboro Company  
Hellige, Inc.

**Pressure Regulators:**

Crane Co.  
The Foxboro Company  
Mueller Co.  
Ross Valve Mfg. Co.

**Provers, Water:**

Pittsburgh Equitable Meter Co.

**Pumps and Pumping Engines:**

DeLaval Steam Turbine Co.  
Ross Valve Mfg. Co.  
S. Morgan Smith Co.  
Sterling Engine Co.  
Worthington Pump & Mach. Corp.

**Pumps, Attached to Steam Turbines:**

A. D. Cook, Inc.  
Worthington Pump & Mach. Corp.

**Pumps, Centrifugal:**

De Laval Steam Turbine Co.  
Worthington Pump & Mach. Corp.

**Pumps, Chemical Feed:**

Everson Mfg. Co.  
International Filter Co.  
Proportioneers, Inc.  
Wallace & Tiernan Co., Inc.

**Pumps, Deep Well:**

A. D. Cook, Inc.  
Crane Co.  
Worthington Pump & Mach. Corp.

**Pumps, Diaphragm:**

Edson Corp.

**Pumps, Hydrant:**

Edson Corp.

**Pumps, Portable:**

Worthington Pump & Mach. Corp.

**Pumps, Power:**

A. D. Cook, Inc.  
Edson Corp.  
Worthington Pump & Mach. Corp.

**Pumps, Sump:**

A. D. Cook, Inc.  
Worthington Pump & Mach. Corp.

**Pumps, Turbine:**

A. D. Cook, Inc.  
Worthington Pump & Mach. Corp.

**Rate Controllers:**

American Water Softener Co.  
Builders Iron Foundry  
The Foxboro Company  
International Filter Co.

**Recorders, Gas Density, CO<sub>2</sub>, NH<sub>3</sub>, SO<sub>2</sub>, etc.:**

Permutit Co.  
Wallace & Tiernan Co., Inc.

**Recording Instruments:**

Builders Iron Foundry  
The Foxboro Company  
International Filter Co.  
Permutit Co.  
Wallace & Tiernan Co., Inc.

- Reservoirs, Steel:**  
Chicago Bridge & Iron Company  
Pittsburgh-Des Moines Steel Co.
- Rust Preventive**  
Rusta Restor Corp.
- Sand, Filtration:**  
Dawes Silica Mining Co.  
Hungerford & Terry, Inc.  
International Filter Co.  
Permutit Co.
- Service Clamps, Galvanized:**  
Farnan Brass Works Co.  
Mueller Co.
- Shaft Linings:**  
Alco Products Div., Am. Loco. Co.
- Sleeves:**  
Crane Co.  
Dresser Mfg. Co.  
Grinnell Co.  
Mueller Co.  
A. P. Smith Mfg. Co.
- Sleeves and Valves, Tapping:**  
Crane Co.  
Ludlow Valve Mfg. Co.  
Mueller Co.  
Rensselaer Valve Co.  
A. P. Smith Mfg. Co.
- Sleeves, Long, River, Split:**  
Dresser Mfg. Co.  
Mueller Co.  
Rensselaer Valve Co.  
A. P. Smith Mfg. Co.  
Warren Foundry and Pipe Corp.
- Soda Ash:**  
Mathieson Alkali Works (Inc.)  
Pennsylvania Salt Mfg. Co.  
Solvay Sales Corp.
- Softeners and Purifiers:**  
American Water Softener Co.  
Everson Mfg. Co.  
Graver Tank & Mfg. Co., Inc.  
Hungerford & Terry, Inc.  
International Filter Co.  
Permutit Co.  
Pittsburgh-Des Moines Steel Co.
- Special Vessels:**  
Alco Products Div., Am. Loco. Co.  
Chicago Bridge & Iron Company  
Worthington Pump & Mach. Corp.
- Stacks:**  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.
- Standpipes, Steel:**  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.
- Steel Plate Construction:**  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.
- Storage Tanks:**  
Alco Products Div., Am. Loco. Co.  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.
- Strainers, Suction:**  
Crane Co.  
Edson Corp.  
R. D. Wood Co.
- Sump Pumps:**  
A. D. Cook, Inc.  
Crane Co.  
Worthington Pump & Mach. Corp.
- Swimming Pool Refiltration System:**  
American Water Softener Co.  
Everson Mfg. Co.  
Hungerford & Terry, Inc.  
International Filter Co.  
Permutit Co.
- Swimming Pool Sterilization:**  
Everson Mfg. Co.  
Permutit Co.  
Wallace & Tiernan Co., Inc.
- Tanks, Elevated Steel:**  
Chicago Bridge & Iron Company  
Pittsburgh-Des Moines Steel Co.
- Tanks, Mixing:**  
Alco Products Div., Am. Loco. Co.  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.
- Tanks, Steel:**  
Chicago Bridge & Iron Company  
Graver Tank & Mfg. Co., Inc.  
Pittsburgh-Des Moines Steel Co.
- Tapping Machines:**  
Mueller Co.  
A. P. Smith Mfg. Co.
- Taste and Odor Removal Plants:**  
Hungerford & Terry, Inc.  
Industrial Chemical Sales  
International Filter Co.  
Permutit Co.
- Taste Removal:**  
Cliffs Dow Chemical Co.  
Industrial Chemical Sales  
International Filter Co.  
Wallace & Tiernan Co., Inc.
- Turbidimeters:**  
Hellige, Inc.  
Wallace & Tiernan Co., Inc.
- Turbines, Steam:**  
DeLaval Steam Turbine Co.  
Worthington Pump & Mach. Corp.
- Turbines, Water:**  
DeLaval Steam Turbine Co.  
S. Morgan Smith Co.
- Valve Boxes:**  
Central Foundry Co.  
Crane Co.  
Ford Meter Box Co.  
Kennedy Valve Mfg. Co.  
Ludlow Valve Mfg. Co.  
Mueller Co.  
Rensselaer Valve Co.  
A. P. Smith Mfg. Co.  
R. D. Wood Co.

**Valve Inserting Machines:**

A. P. Smith Mfg. Co.

**Valves, Altitude:**

Ross Valve Mfg. Co., Inc.

S. Morgan Smith Co.

**Valves, Check, Flap, Foot, Hose,**

**Mud and Plug:**

A. D. Cook, Inc.

Crane Co.

Ludlow Valve Mfg. Co.

Mueller Co.

Rensselaer Valve Co.

S. Morgan Smith Co.

R. D. Wood Co.

**Valves, Detector Check:**

Hersey Mfg. Co.

Grinnell Co.

**Valves, Float:**

Crane Co.

Ludlow Valve Mfg. Co.

Ross Valve Mfg. Co., Inc.

S. Morgan Smith Co.

**Valves, Gate:**

Crane Co.

Dresser Mfg. Co.

Kennedy Valve Mfg. Co.

Ludlow Valve Mfg. Co.

Mueller Co.

Rensselaer Valve Co.

A. P. Smith Mfg. Co.

R. D. Wood Co.

**Valves, Large Diameter:**

Alco Products Div., Am. Loco. Co.

Crane Co.

Kennedy Valve Mfg. Co.

Ludlow Valve Mfg. Co.

Rensselaer Valve Co.

A. P. Smith Mfg. Co.

S. Morgan Smith Co.

R. D. Wood Co.

**Valves, Regulating:**

Crane Co.

Mueller Co.

Ross Valve Mfg. Co.

S. Morgan Smith Co.

**Valves, Relief (Temperature and Pressure):**

Crane Co.

Kitson Co.

Mueller Co.

S. Morgan Smith Co.

**Valves, Swing Check:**

Crane Co.

Grinnell Co.

Kennedy Valve Mfg. Co.

Ludlow Valve Mfg. Co.

Mueller Co.

Rensselaer Valve Co.

A. P. Smith Mfg. Co.

R. D. Wood Co.

**Valves, Uniflow Check (for Double Check Service):**

Grinnell Co.

**Valves, Water Meter Protection:**

Crane Co.

Kitson Co.

**Water Softener (Hot Lime Soda):**

American Water Softener Co.

International Filter Co.

Permutit Co.

**Water Softener (Zeolite):**

Hungerford & Terry, Inc.

International Filter Co.

Permutit Co.

**Water Softening Plants:**

American Water Softener Co.

Chicago Bridge and Iron Company

Everson Mfg. Co.

Fuller & Everett

Graver Tank & Mfg. Co., Inc.

Hungerford & Terry, Inc.

International Filter Co.

Permutit Co.

Pittsburgh-Des Moines Steel Co.

**Water Supply Contractors:**

A. D. Cook, Inc.

**Water Testing Apparatus:**

Everson Mfg. Co.

Hellige, Inc.

W. A. Taylor & Co., Inc.

Wallace & Tiernan Co., Inc.

**Water Treatment Plants:**

American Water Softener Co.

Everson Mfg. Co.

Graver Tank & Mfg. Co., Inc.

Hungerford & Terry, Inc.

International Filter Co.

Permutit Co.

Pittsburgh-Des Moines Steel Co.

Wallace & Tiernan

**Water Waste Detection:**

Builders Iron Foundry

Pitometer Co.

**Water Works Construction, General:**

Pittsburgh-Des Moines Steel Co.

**Well Drilling Contractors:**

A. D. Cook, Inc.

**Well Screens:**

A. D. Cook, Inc.

Crane Co.

**Wrenches, Ratchet:**

Crane Co.

Dresser Mfg. Co.

**Zeolite Water Softeners:**

American Water Softener Co.

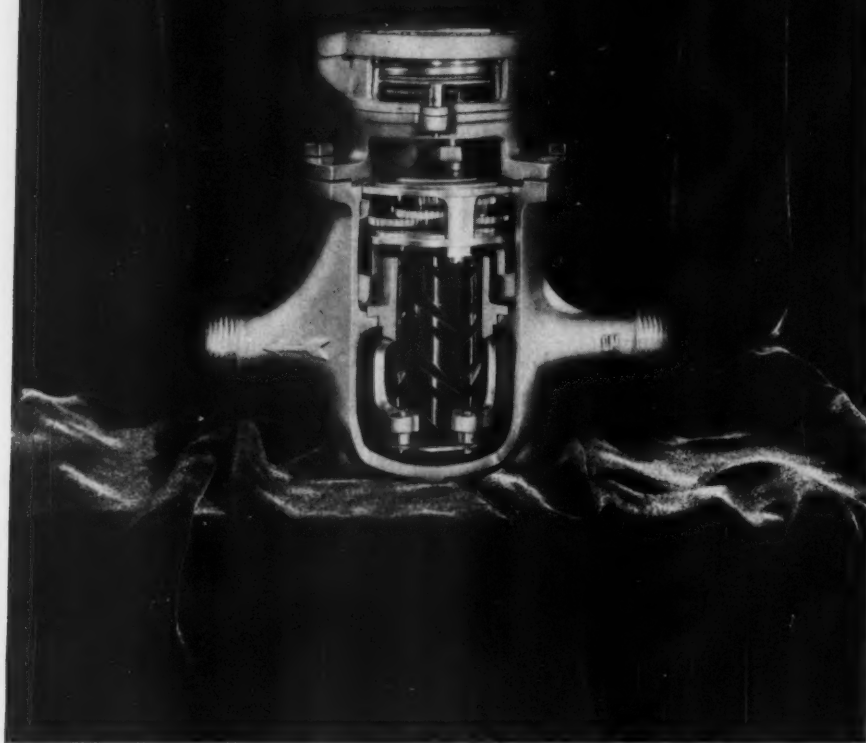
Graver Tank & Mfg. Co., Inc.

Hungerford & Terry, Inc.

International Filter Co.

Permutit Co.

# PITTSBURGH **IMO** WATER METER



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